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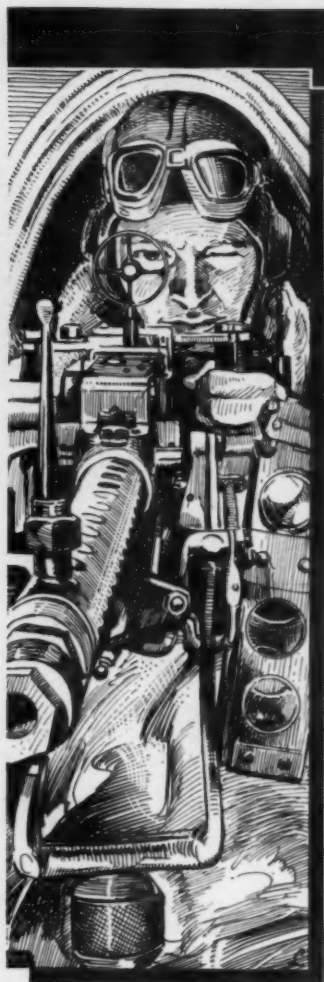
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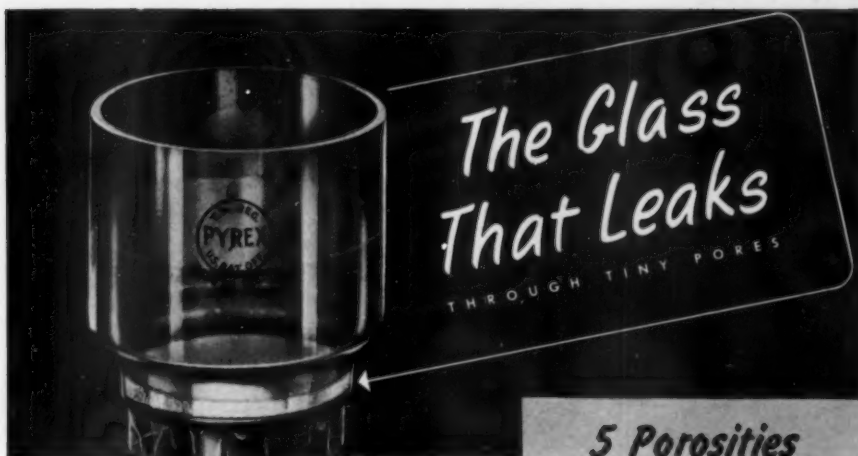
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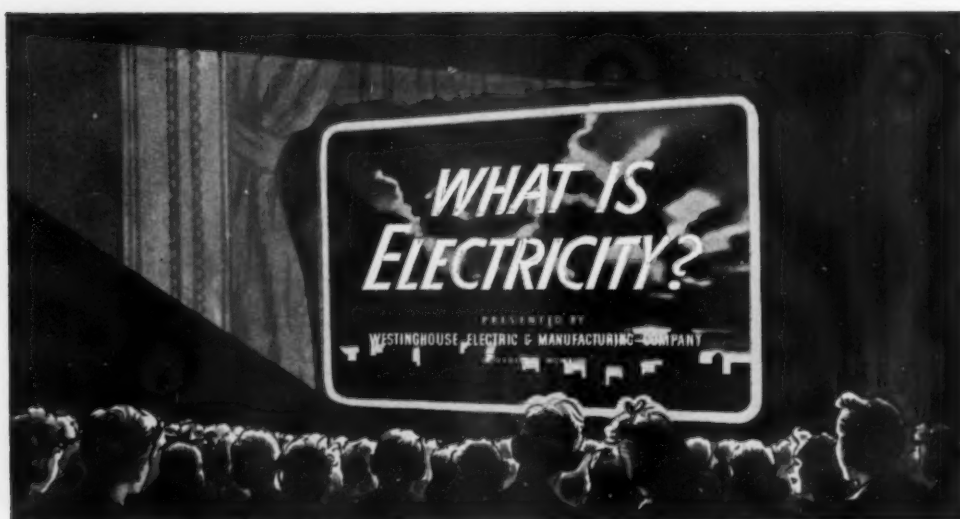
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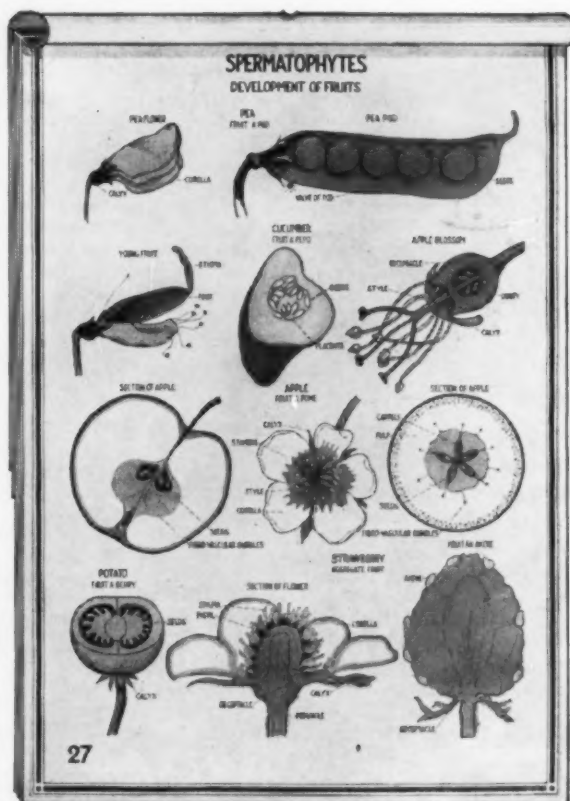
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VOLUME X

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Bitter, Sour and Salty

C. W. BENNETT

Western Illinois State Teachers College

Macomb, Illinois

CHEMISTRY, like all other branches of human knowledge has undergone a long period of evolution. The ideas of acids, bases and salts are no exception. Of course sour substances long before Priestley were called acids. However the discovery of oxygen marks a turning point in Chemistry and it is noteworthy that Lavoisier, about 1790, named oxygen (acid producer) because he believed that oxygen was the "acidifying principle." To him oxides of non-metals such as SO_3 , SO_2 , CO_2 were "acids" (We would call them acid anhydrides) and oxides of metals such as CaO , MgO were bases, although it is doubtful if he knew of their oxygen content since they had not then been reduced to their free form.

In the years following Lavoisier it became apparent that the water molecules which these anhydrides added were important and for example the accepted sulfuric acid formula changed from SO_3 to H_2SO_4 , calcium hydroxide from Ca O to Ca(OH)_2 so that Arrhenius in 1887 could say that an acid was a hydrogen ion (H^+) donor in water and a base was a hydroxide ion (OH^-) donor in water. Emphasis had now shifted from oxygen, which is not even found in all acids, to hydrogen which is a constituent of all the commonly accepted acids. This new idea was slow in gaining adherents but is now universally held. The disquieting thing about this is that now, that we should be taking another step forward, many have just reached 1887 in their thinking.

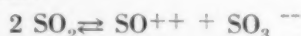
IN 1923 Brönsted and others extended the concept of acids to include hydrogen ion

donors under all conditions where Arrhenius had limited it to water solutions. The hydrogen ion (H^+) was now called a proton since a hydrogen atom (consisting of one proton and one electron) loses its electron to become the ion. (Of course it is now believed that the proton like the electron is so small that it probably never exists as an independent particle but is associated with a molecule of the solvent. Thus in water one would have H_3O^+ , hydronium ions, in ammonia, NH_4^+ ions, and in glacial acetic acid $\text{H}_2\text{C}_2\text{H}_3\text{O}_2^+$ ions). The base, however, has an entirely new, but more logical, definition, being defined as a proton acceptor in general.

Brönsted's acids would include H^+ , H_3O^+ , NH_4^+ , HCl , H_2SO_4 , $\text{HC}_2\text{H}_3\text{O}_2$ etc., all of which are capable of furnishing a proton. His bases would include "acid radicals" such as OH^- , CN^- , $\text{C}_2\text{H}_3\text{O}_2^-$, HSO_4^- , SO_4^{--} , Cl^- since they can accept (combine with) a proton (H^+) to become an electrically neutral molecule. Those bases like OH^- , CN^- , $\text{C}_2\text{H}_3\text{O}_2^-$, which readily combine with the proton to form a slightly ionized molecule, i. e. weak acid, are classified as strong bases while such bases as SO_4^{--} , Cl^- , NO_3^- which form highly ionized molecules, i. e. strong acids, are weak bases. Besides "acid radicals," Brönsted includes such neutral molecules as H_2O , NH_3 and NH_2OH as well as organic amines which form "onium" ions by accepting protons to form H_3O^+ , NH_4^+ , $\text{NH}_2\text{OH}\cdot\text{H}^+$, RNH_3^+ ions which in their turn now become acids. Water ammonia and many others, capable of furnishing a proton by ionization or of accepting an extra proton by a dative covalence, are

classed as amphiprotic (ampholytic or amphoteric) since they are both acids and bases. The base now is actually the *base* or foundation of a certain acid. The acetate ion is the base of acetic acid. A weak base belongs to a strong acid while a strong base belongs to a weak acid. This new use of the word base is a first confusing because it is different from the classical *base* which Brönsted would define as a salt *containing a strong base*, but it does have logic on its side.

Germann, in 1925, presented a further extension of the nomenclature to include as acids all entities which possess a cation in common with that of the solvent and bases those which possess an anion common to the solvent. Thus for water solution, water ionizes $\text{H}_2\text{O} \rightleftharpoons \text{H}^+ + \text{OH}^-$ (no doubt the H^+ is solvated to H_3O^+ ion). So that any substance which furnishes a H^+ ion is an acid in water while anything which furnishes OH^- is a base in water. Now if liquid ammonia is the solvent and it ionizes $\text{NH}_3 \rightleftharpoons \text{H}^+ + \text{NH}_2^-$ (the H^+ immediately solvating to NH_4^+) any substance which furnishes H^+ or NH_4^+ ions is an acid, while bases must contain NH_2^- ions, for example, sodamide, NaNH_2 . But NaOH would be merely a salt here. If glacial acetic acid were the solvent any acetate would be a base. This is a most intriguing idea and leads to some pleasing anomalies like the one where H_2SO_3 would be a base in liquid SO_2 which ionizes:



Lewis, in 1927 and again in 1938, presented the more inclusive idea of acid as an electron pair acceptor. "An acid is a molecule, ion or radical, capable of accepting a pair of electrons furnished by some element or group. Conversely a base is a structure which can furnish such an electron pair." At first the "electron pair acceptor" acid seems contradictory to Brönsted's "proton donor" acid but remembering that a proton is practically the opposite of an electron, we see that the two ideas are reconcilable and that Lewis can include such cations as Al^{+++} and Zn^{++} which always make sour (acid) solutions as well as SnCl_4 , SO_3 etc. in his acids where Brönsted could not.

SIDGEWICK, in 1927, suggested the use of the word "acceptor" instead of acid and "donor" for base to distinguish the Lewis idea from the classical acid and base. This has its advantages but has not been generally adopted.

Usanovich, in 1939, uses the term electrophile (electron-loving) for acids and includes as well all oxidizing agents. In the opinion of the writer this is too inclusive.

The table at the top of the following page summarizes the foregoing material.

IN THE opinion of the writer the Lewis ideas are most reasonable and the rest of this article will deal with them. Acids may be (1) cations since under some condition any cation may accept an anion to form a covalent compound which will be more or less firmly bound. Or (2) certain molecules may be acids because they will accept a molecule of solvent to form "onium" ions or (3) certain anions, chiefly of the "acid salt" type like HSO_4^- may also be acids since they can accept a solvent molecule. (The last group are also bases and are therefore amphiprotic).

The following table classifies Lewis acids according to type and strength:

Cations	Molecules	Anions
Strong		
H_3O^+	HCl HBr HI HNO_3 H_2SO_4 (first H^+) SO_3	
Medium		
	$\text{H}_2\text{C}_2\text{O}_4$ H_3PO_3 SO_2 H_3PO_4 HF	CrZO_7^- HSO_4^-
Al^{+++}		
Weak		
Zn^{++}	$\text{HC}_2\text{H}_3\text{O}_2$ CO_2 H_2S H_3BO_3 HCN	H_2PO_4^-
Fe^{+++}		
NH_4^+		

<i>Acid</i>		<i>Base</i>
Oxide of non-metal $\text{SO}_3, \text{SO}_2, \text{CO}_2$	Lavoisier 1790	Oxide of metal CaO, MgO
Hydrogen ion donor in H_2O $\text{HCl}, \text{H}_2\text{SO}_4, \text{HC}_2\text{H}_3\text{O}_2$	Arrhenius 1887	Hydroxide ion donor in H_2O $\text{NaOH}, \text{KOH}, \text{NH}_4\text{OH}$
Proton (H^+) donor in general $\text{H}^+, \text{H}_3\text{O}^+, \text{HCl}, \text{H}_2\text{SO}_4, \text{HC}_2\text{H}_3\text{O}_2$	Brönsted 1923	Proton acceptor in general $\text{OH}^-, \text{C}_2\text{H}_3\text{O}_2^-, \text{SO}_4^{2-}, \text{NH}_3, \text{H}_2\text{O}$
Solvent-cation donor $\text{H}^+, \text{OH}^-; 2\text{NH}_3 \rightleftharpoons \text{NH}_4^+ + \text{NH}_2^-$ $\text{HCl}, \text{NaOH}, \text{NH}_4\text{Cl}, \text{KNH}_2$	Germann 1925	Solvent-anion donor $\text{H}^+ + \text{C}_2\text{H}_3\text{O}_2^-$ $\text{HCl}, \text{NaC}_2\text{H}_3\text{O}_2$
Electron-pair acceptor	Lewis 1923 and 1938	Electron pair donor
Acceptor	Sidgwick 1927	Donor
More inclusive — electrophile	Usanovich 1939	

Very weak	Medium	
Na^+ HOH HPO_4^{2-}	NH_3	H_2BO_3^- HPO_4^{2-} HCO_3^- $\text{C}_2\text{H}_3\text{O}_2^-$
K^+		
Etc		

Lewis "bases" include (1) cations such as $\text{Zn}(\text{OH})^+$ and AlO^+ which contain a hydroxyl or oxygen since these groups may unite with H^+ . (2) Molecules, like H_2O and NH_3 , may be bases if they can furnish a pair of electrons for a dative covalence and (3) all anions may be bases since they can furnish a pair of electrons for a proton (H^+) to join in the same manner.

Weak		
$\text{Zn}(\text{OH})^+ \quad \text{H}_2\text{O}$ AlO^+		F^- H_2PO_4^- SO_4^{2-} HC_2O_4^-
Very weak	$\text{HC}_2\text{H}_3\text{O}_2$	HSO_4^- Cl^- Br^- I^-

BASES (Electron-pair Donors)

<i>Cations</i>	<i>Molecules</i>	<i>Anions</i>
Strong		OH^- PO_4^{3-} CN^- HSiO_3^- O^{2-}

IT SHOULD be noted here that this use of the "base" for anions and "acids" for most cations is in direct contrast to the usage in Soil Chemistry and in some older qualitative analysis texts, where the metallic ions (cations) are called "bases", and anions (acid radicals) are called acids, including even OH^-

Continued on page 32

Editorial and News

Teaming Up the Science Club in a War Program

WHAT can the science club do in a war program? It can do much. When there is not enough space in our science courses for the many things needed in an all out training for war, why not remember the science club. It provides a means of attaining many goals. Such special problems as the air plane, high altitude flying, first aid study, the victory garden, keeping healthy, radio, photography, ballistics, incendiaries, war gases, chemicals in war, may not fit into the regular program of classes to the extent desired. The club organization allows much latitude in the choice of problems to study and to work on as projects. Furthermore, in the club students are usually working more on their own initiative and so will spend far more energy than they will on the usual class assignment. Why not capitalize on their surplus energy. In all the areas already mentioned and in many more, good leadership in the science club can produce many useful and often outstanding outcomes of value in a war training program.

What else can the science club do? It can build interest in science. It can attract more of the boys and girls of ability into the science field. As we entered World War II, we, as science teachers, were indicted for being "caught short in a science training program" that would permit mass training of armed forces. War had become a job for scientifically trained men, and not enough of the men had been trained in science. Those that did have some science background were in general below the standard needed for rapid adjustment to the scientific equipment of modern war. So it is essential that science teachers spend some of their time and energy in selling science to the boys and girls that have the native ability to do outstanding work in this field. It is not enough to assume that in the course of events all students who should be in science are there. The fact is that the

science area may not get its fair share of the talented people. Certainly in most high schools, the physics and chemistry classes are small as compared to the school population as a whole.

FOR SELLING science to students there is no better means than the science club. It stimulates interest through the activities of the members themselves, which is the most potent means of motivation known. Students are more impressed by the work of their fellows and with their own satisfying activities than by all the talking the teacher may care to do. Further, club activities in a less formal atmosphere than the class, allows the students to become better acquainted with the science teacher, or teachers, through satisfying relationships. This is a vital feature.

Where can we get help with the club program? If we want to make the most of our club work, we will want all the ideas we can get. We should get in touch with other clubs, and find what they are doing. Join the Junior Academy of Science of our own state; it is most stimulating and helpful. Participate in its activities. Exhibits of work can be local. Probably there is where they will do the most good anyway. Join a national organization and search the science journals for aids. *The Science Teacher* maintains a club section to help teachers build stronger and more useful club organizations. Write us about your work and your problems and possibly we can pass it on to help others or to get help for yourself.

Articles Wanted for Publication

We are always looking for good material for publication. If you have written an article, send it to us. We are especially anxious to secure more demonstrations, projects, and other activity material. What are you doing that would help other teachers? Write us about it.

Council Notes

Edited by NATHAN A. NEAL, Secretary
AMERICAN COUNCIL OF SCIENCE TEACHERS

THE NEEDS of the Army for men trained in certain specialized fields were expressed by the publication in 1942 of a series of Pre-Induction bulletins addressed to the civilian schools of the nation. In them it was suggested that the facilities of schools might be so organized as to provide training, in basic subject-areas, to boys facing early induction into the country's armed forces, which would make more effective the training received after induction.

In the publications, *Fundamentals of Electricity* and *Fundamentals of Machines*, there were indicated a number of knowledges and skills in those fields which the Army found essential to military operations in which pre-induction training would be of real value to the soldier and, because of that, to the Army. The suggestions of this bulletin were widely accepted as a challenge to their best efforts by teachers and administrators who were desirous of making effective contributions to the war

ISSUED under pressure of the exigencies of warfare, and to emphasize the importance of a quick response to the expression of Army needs, there were omitted from the bulletins certain items whose inclusion might have proved helpful to teachers of pre-inductees. For example, need for the inclusion of help to the teacher is reflected in repeated recent requests for applications of the principles of mechanics and electricity to specific Army problems and situations. Particularly has this been felt by those teachers whose opportunities for acquiring first-hand information have been curtailed by very limited access to sources of information. There are also those whose previous experience in teaching may have been in other fields and whose emergency service as teachers of pre-induction science is severely handicapped thereby.

During the summer of 1942 a group of teachers from several different states met in Washington to discuss the possible need for supplements to the Pre-Induction Mechanics

and Pre-Induction Electricity bulletins. Following this a smaller group of teachers was called back to Washington to write such supplementary bulletins in terms of the recommendation, which had come out of the previous conference.

THESE two supplementary bulletins are promised in the near future. Each will include an expanded general statement which reviews the purpose of the original bulletins as well as the developing objectives which have called for the supplements. This introductory material is intended primarily to be used as a means of orientation for teachers new to the field of pre-induction work. A careful foreward which indicates something of the most successful teaching procedures yet devised for pre-induction work is directed to the teachers, who will use the bulletins. These forthcoming supplements list selected Army technical and field manuals which contain instructions for application of the principles of mechanics and electricity, contained in both the original and supplementary bulletins. The supplements each contain samples of fully developed teaching outlines including extensive military applications of scientific principles. Following the examples of fully-developed teaching outlines, the supplements list military applications for all of the subject-matter material contained in the original bulletins on Pre-Induction Electricity and Pre-Induction Mechanics.



Journal Service to American Council Members

For the information of members of the *American Council of Science Teachers*, the membership year begins September 1 and ends August 31 of the following year, but the magazine year for *The Science Teacher* to members is from December through the October issue. This arrangement allows time to get your membership renewed and to get the magazine mailing list made up for the year.

Chemistry in the Liberal Arts Colleges

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IT IS quite possible that nearly all teachers of chemistry in the arts colleges have had, at one time or another, to stand up and fight for a curriculum which will permit his majors to take in college those courses which he knows to be essential to the success of his students. I have had a few skirmishes myself, and it was for this reason I recently sent out a questionnaire. I wanted to know what other schools

were doing, so that when questions arose I could speak with authority.

The sampling I made was probably highly unscientific. Questionnaires were sent to all of the nearby colleges of liberal arts and to selected colleges in adjacent states. None was sent to the large universities and none to teachers colleges. A few were sent to more distant schools where the professor in charge

Chart 1. CHEMISTRY COURSES OFFERED

NUMBER	GENERAL CHEMISTRY		QUAL. ANALYSIS		QUANT. ANALYSIS		ORGANIC CHEMISTRY		PHYSICAL CHEMISTRY		BIOLOGICAL CHEMISTRY		QUALITATIVE ORGANIC		OTHER ADV. COURSES	USUAL TOTAL FOR MAJORS	REMARKS
	R	L	R	L	R	L	R	L	R	L	R	L	R	L			
1	6	3	3	2	2	6	6	4	4	4	2	1				43	
2	6	2	3	3	2	4	6	2	6	2			1	3	7	47	
3	4	4	2	1	1	3	4	4	4	4					6	38	
4	4	4	2	2	2	6	5	3	3	1						32	
5	6	4			4	4	4	4	3	3	3				4	40	
6	6	2	1	2	4	4	6	4	6	2					2	39	4 years mathematics, 3 years physics.
7	4	4	2	4	2	5	4	4	6	4			1	2	6	43	
8	4	4	2	2	2	6	6	4	6	2			1	2	6	44	Only 40 count on degree.
9	6	2	3	2	4	4	4	4	6	2			1	2	5	42	Calculus and physics.
10	4	4	2	2	1	6	4	6	4	4						37	20 mathematics, 10 physics.
11	6	4	1	2	2	5	6	4	6	2	2	1			5	45	Only 40 count on degree.
12	4	4	2	2	1	3	4	4	6	2						32	
13	6	4	1	2	4	5	6	4	6	2	2	1	2	2		42	
14	6	2	2	2	2	6	5	3	4	4					2	37	
15	6	4	2	2	3	3	4	4	3	3					6	40	
16	6	4	2	3	2	3	6	4	6	2						38	Calculus and physics.
17	6	4			6	4	6	4	6	2			1	2	4	45	Calculus and physics.
18	4	4			4	4	6	4	6	2	2	2			4	45	
19	6	4	1	3	2	7	6	4	5	3	1	3	3			40	Calculus and physics.
20	4	4	2	2	2	2	4	4	4	4					4	36	
21	6	2	2	2	4	4	4	4	6	2					6	40	B. S. Subst. mathematics for part of language.
22	6	4			2	6	6	4	6	2			3		6	45	
23	4	4	2		3	3	4	4	6	2					6	38	
24	6	2			4	6	4	4	4	4	2		2		10	43	Calculus and physics.
25	6	4			2	6	6	4	6	4	3	3				38	
26	6	4			4	4	6	4	6	3			2	2	4	43	Calculus and physics.
27	6	2	2		4	4	8	2	6	2	6	2			6	42	
28	6	4			2	6	6	4	6	2	3		3			39	Mathematics 20, physics 16.
29	4	4	2	2	1	3	5	5	6	2			1	3		38	Calculus and physics.
30	6	2	1	1	3	3	6	2	6	2	2	1	1	1	2	36	Calculus and physics usually.
31	5	3	2	2	2	2	4	4	2	1	2	2	2	2	3	32	
32	6	4	2	3	2	3	6	4	4	6	3	2			5	45	
5.34	3.43		1.31	1.68	2.68	4.28	5.22	3.84	5.12	2.62	1.48		1.49		3.41	40.4	This total does not include biochemistry which is seldom taken by majors.
Sums	8.77		2.99		6.96		9.06		7.74		1.48		1.49		3.47	40.4	
A.C.S.	9.		8.				10		8.						3.3	38	(For "Professional Chemist.")

8.7 4. 6.1 8.3 7. Reported in J. Chem. Ed. 16, 575, 1939, as a summary of the courses offered in 407 colleges. Reported also that 68.7% of these colleges required 2 yrs. math., 88.5% required 1 year of physics, 94.3% 1 year of English, 42.5% required German, 21.9% required French, and 41.9% required either German or French.

Chart 2. GENERAL CURRICULUM REQUIREMENTS

1	2	3	4	5	6	7	8	9	10	11	12	13
NUMBER	ENGLISH COMP.	ENGLISH LITERATURE	FOREIGN LANGUAGE	HUMANITIES SURVEY	FINE ARTS	RELIGION	PHILOSOPHY	PSYCHOLOGY	BIOLOGICAL SCIENCE	SOCIAL SCIENCE	HISTORY	NATURAL SCIENCE
1.	6	6	6-12	..	..	2	..	6	..	6	..	8
2.	4	6	12	..	3	3	..	..	3	3	..	7
3.	6	6	6	..	..	..	6	..	..	..	6	8
4.	6	4	1-2 y	..	..	8	..	6	..	13	..	14
5.	6	6	6-12	6	..	..	..	..	..	15	..	12
6.	6	..	2 y	8	..	..	..	..	..	12	..	8
7.	6	6	10	..	..	..	6	..	..	6	..	8
8.	6	4	6-12	..	..	6	..	6	..	6	..	12
9.	6	..	2 y	..	6	..	6	..	..	6	..	8
10.	8	3	14	..	..	6	..	3	..	..	6	15
11.	6	..	16	..	..	..	6	..	..	6	..	6
12.	6	6	6-18	..	..	6	6	..	..	6	..	8
13.	6	..	2 y	..	..	..	6	..	..	6	..	8
14.	8	..	16	..	4	..	..	..	..	12	..	12
15.	6	6	12	..	..	3	..	..	..	12	..	12
16.	8	..	12	..	3	6	3	3	..	12	..	10
17.	6	6	2 y	..	..	3	..	..	..	12	..	8
18.	6	6	14	..	..	..	3	..	..	4	6	12
19.	6.7	..	2 y	..	2.7	..	..	..	..	10	..	10
20.	6	4	6	..	..	3	..	6	..	6	..	8
21.	6	6	1-3 y	..	..	..	6	..	..	6	..	8
22.	6	..	14	..	..	5	..	..	..	10	..	14
23.	6	..	Read	4	..	..	3	..	..	6	3	9
24.	6	..	..	..	6	6	6	..	..	6	..	8
25.	6	6	14	6	..	..	8	..	..	6	..	8
26.	6	6	8-16	..	..	8	6	..	..	6	..	8
27.	6	..	2 y	..	4	8	..	..	..	12	..	12
28.	3	4	14	..	..	5	..	5	..	10	..	8
29.	6	3	16	..	..	4	..	..	6-8	6	8	14
30.	8	..	1-2 y	8	..	2	..	..	2	6	..	8
31.	6	3	16	..	..	4	..	3	..	6	..	8
32.	5	5	25	10	..	..	..	..	..	16	..	10
Means	6.08	3.28	*	1.88	.89	3.27	2.15	.73	.31	7.75	.91	9.66

Summary: English composition and speech.....6.08
 Foreign language (Not attempted).....
 Humanities; sum of columns 3, 5, 6, 8.....8.10
 Religion (including half of optionals).....3.27
 Social science; sum of columns 9, 11, 12.....9.39
 Natural Science; sum of columns 10 and 13.....9.97

was personally known to the writer. Others were included for purely political reasons, i. e., members of our faculty had gone there, or had taught there or believed that that particular school could do no wrong. Thirty-four were sent out and 32 responded. This is almost a record and testifies to the fact that other teachers are confronted with the same problem.

THE PURPOSES of the questionnaire were—

1. To find what other colleges offer in the department of chemistry and how much the average chemistry major takes.
2. To find what other colleges require of their chemistry majors in the way of non-science courses.
3. To find what work in science is required

of students not majoring in one of the sciences. The results are summarized in the two charts adjoined. The following comments will help in their interpretation.

Chart 1 shows the chemistry curriculum and Chart 2 the general requirements. In both charts the numbers in the first column refers to the school. The other numbers are semester hours credit offered or required. *R* signifies class-work and *L* laboratory. In some cases the credit allowed for laboratory required evaluation on my part. Some of the schools were on the quarter system and some reported on the number of clock hours. For general chemistry 2½ hours per week in the labora-

Continued on page 42

Apparatus to Demonstrate Pressure in a Liquid

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PRACTICALLY every physics textbook has a diagram and discussion on some type of simple apparatus to demonstrate the relation between pressure and depth of a liquid. Usually the apparatus consists of a thistle tube covered with a rubber diaphragm to which is attached some kind of pressure indicating device, a manometer. The whole equipment is moved up and down in a battery jar of water or other liquid. While this is a suitable method to demonstrate this principle, it has limitations. The depth is limited to about a foot or less; the results are relative rather than absolute.

The equipment shown here differs in that the liquid is placed in a long tube, $3\frac{1}{2}$ feet long, and is moved up and down over the diaphragm covered thistle tube. The pressure measuring apparatus is fastened securely in place on a piece of wall board or other sup-

port, 40 inches by 36 inches, as is shown in the photograph and drawing.

The large tube containing the liquid is a resonating tube $3\frac{1}{2}$ feet long and at least 40 mm in diameter. This tube is placed between a meter stick on the left and a yard stick on the right. These scales are screwed on small blocks of such thickness as to form a groove in which the tube will freely slide up and down.

ON THE left side are fastened two tubes with yard sticks on the outside of each and a meter stick between them. The tube at the right is a Mohr burette fitted for a pinchcock and rubber tubing, such as is used in chemistry. The tube at the left is a common glass tube 8 or 10 mm in diameter drawn out to fit $\frac{1}{4}$ inch rubber tubing. The lower ends of these tubes are connected to a Y shaped tube fitted with a pinchcock. The top of the



Measuring
pressure
in a
liquid
accurately.

burette has inserted a thistle tube to fill it with water—distilled water in which is dissolved a trace of congo red to make the manometer visible to all parts of the room. The left arm of this open manometer is a plain glass tube; the right arm is graduated in cubic centimeters by one fifth of a cubic centimeter.

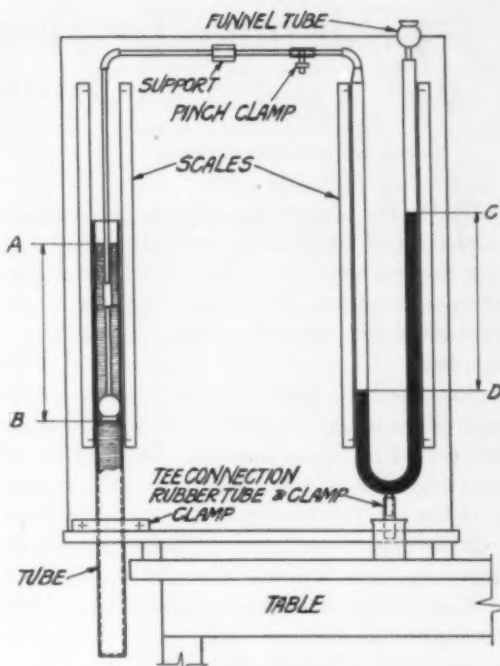
The piece of wall board with the equipment and metric and English scales attached, is then secured upright to a base. The base is made of two pieces of 2 x 4 about a foot long upon which is placed a board 40 inches by 10 inches. Note that it is so arranged that the left end extends over the edge of the table in order that the long tube holding the liquid can extend to the floor. A hole of suitable size to accommodate the tube is bored through the base board. On top of this hole two wood strips held together with a carriage bolt fitted with a wing nut serve to clamp the tube in place. These strips have a layer of felt glued on the inner edge to hold the tube tight and prevent breakage.

THE ATTACHING of the rubber diaphragm to the thistle tube should be carefully done. Upon a plane surface place the rubber flat, not stretched. Gently warm the edge of the thistle tube and coat with rubber cement. Press it firmly upon the sheet of rubber. When cool, it will be tight. Wrap it then in the usual manner with a rubber band or string; avoid any stretching or tension.

Fill the large tube with water and slip it over the thistle tube. The upward pressure against the rubber diaphragm, being unbalanced, will distend the latter, rendering it concave as seen from below, and forcing it into the thistle tube. This force is now balanced by pouring water into the open arm of the manometer tube or burette until the rubber diaphragm has resumed its original contour.

The difference in level between the two columns of water in the manometer CD as shown in the drawing will be the same as the distance the rubber diaphragm is below the surface of the water AB. In the photograph, the student at the right adjusts these levels while the student at the left notes the contour of the rubber diaphragm.

DECEMBER, 1943



Arrangement of Apparatus for measuring pressure in a liquid.

In water AB will always equal CD. If brine or some heavier liquid is used, AB will be less than CD, when the diaphragm is plane. (Water is always used in the manometer.) By this method a column of brine AB is balanced against a column of water CD. The density of the brine may be determined as

$$\text{Density of brine} = \frac{A B}{C D}$$

A LIQUID lighter than water, such as gasoline or oil can be placed in the large tube. A diaphragm of "Neoprene" or some material not attacked by oil should be used instead of common rubber. In this case the height of CD will be less than AB, when CD is adjusted. The density of gasoline may be determined as

$$\text{Density of Gasoline} = \frac{C D}{A B}$$

This equipment will demonstrate:

1. That the pressure within a liquid mass increases from the surface downward in direct proportion to the depth.
2. The pressure at a given depth below the surface is proportional to the density of the liquid.
3. The density of a liquid can be determined.

A Substitute for Fleming's Right Hand Rule

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Technical Editor

College Entrance Book Company

New York, New York

During the preparation of a recent textbook in physics, it was one of my duties to supervise the drawing of a number of diagrams. Among these was one illustrating Fleming's right hand rule, as well as several based upon that rule.

Now teachers and students may on occasion wink at a typographical error in text, but errors in diagrams are fatal. This is especially true when a diagram is, categorically, either right or wrong, and actually happens to be wrong. As a result, I found myself in numerous consultations with the author and with the artist, deciding whether the current went into the paper or came out of the paper, or possibly followed some hitherto unsuspected path. The manual contortions which accompanied these discussions probably resembled a heated deaf-mute argument on politics. Yet to this day, despite intensive practice, I can never apply Fleming's rule to any given situation in much under two minutes, nor am I ever sure of my result in any case.

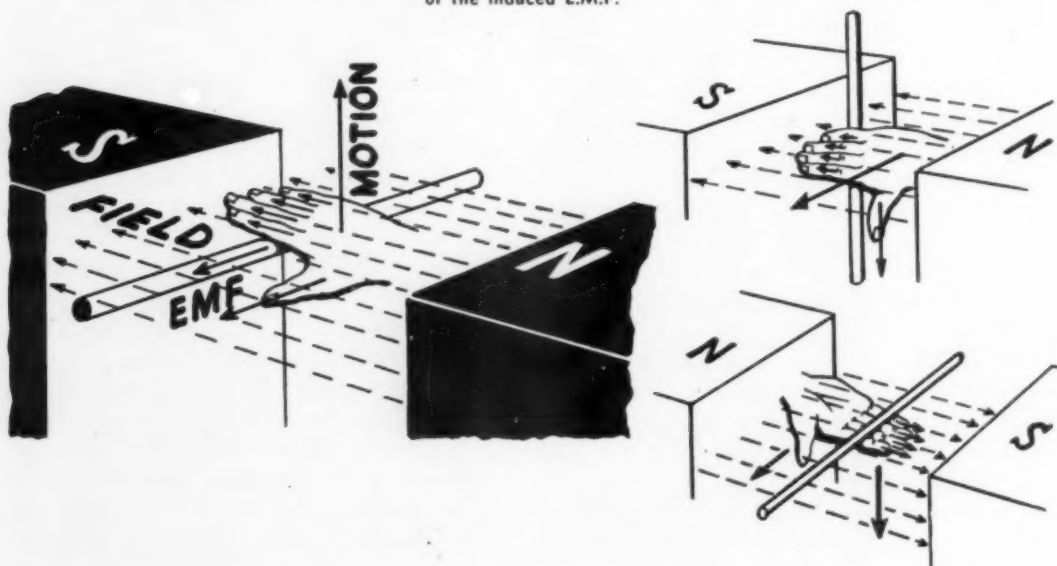
I imagine that there are many physics students who suffer silently under the same handicap.

THE PURPOSE of this article is to suggest a new version of Fleming's rule which seems to me to be easier to remember, easier to execute, and more logical in derivation. Had I the courage of conviction, this suggestion would have replaced Fleming's rule in the text I have mentioned. More sober minds, however, convinced me that a physics text without Fleming's rule in its traditional form would be too bizarre for publication. I consequently take this safer means of expression instead.

The Method

THE DIAGRAMS of Fig. 1 show the suggested procedure. You extend the four fingers of the right hand in the direction of the magnetic field from N to S, and then turn the hand until the palm opposes the motion of the conductor. (In this position,

Fig. 1. When back of hand faces direction of motion of wire the thumb points in the direction of the induced E.M.F.



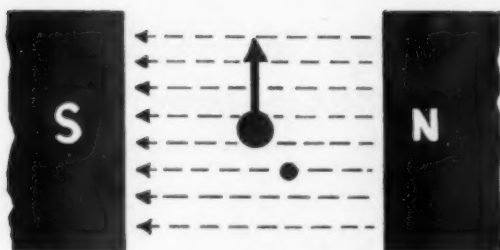


Fig. 2. Magnetic field with conducting wire moving up.

the back of the hand faces in the direction of motion.) If you then extend the thumb parallel to the conductor, it points in the direction of the induced E.M.F.

I believe this method has several advantages over the older rule. It is relatively easy to apply because the fingers and thumb are always in natural, easy-to-assume positions. Furthermore, there is a certain logic in having the fingers represent lines of force, and in having the hand appear to "hold back" the moving conductor. The entire operation seems to be a symbolic representation of Lenz's Law. From the student's point of view, there is nothing new to remember about the significance of the fingers: as in the right hand thumb rule for the magnetic field about a conductor the fingers are lines of force and the thumb is the direction of current. And as might be expected from all these similarities, this new method is actually an outgrowth of Lenz's Law and the right hand thumb rule, as the following discussion shows.

The Explanation

CONSIDER what happens as the conductor moves across the field. Let us assume that the magnetic field runs from right to left across the paper (Fig. 2), and that the conductor, normal to the page, is moving up. As the conductor moves, the number of lines of force above it decreases, while the number below it increases. In other words, the field above the conductor is growing weaker in total strength, and growing stronger below it.

To the electrons in the conductor, this is an intolerable situation, about which something must immediately be done. They therefore attempt to flow one way or the other, whichever promises to put a quick stop to this

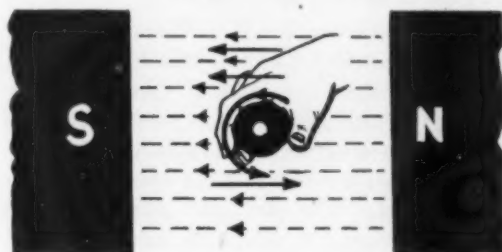
annoying disturbance of the surrounding field. To put it in more elegant language, an induced current will flow (or an induced E.M.F. will act to produce a current flow) in such a direction as to oppose the change in magnetic field producing it.

In Fig. 3, we see by the right hand thumb rule that a conventional current flowing out of the page toward us will have the desired effect: a new magnetic field will curl around the conductor (counterclockwise) strengthening the field above (where it needs strengthening) and weakening it below (where a moment ago it was getting stronger). If we now uncurl our fingers we find that the hand is in the proper position for indicating the direction of induced E.M.F. under our new rule. We also see that, no matter what the direction of motion of the conductor, the hand must be placed so that the outstretched fingers reinforce the field on the side the conductor is approaching; moreover, it must be in position to curl around the conductor and weaken the field on the side being left behind. If these conditions are met, the thumb will always show the direction of induced E.M.F.

Conclusion

Fleming's rule is a small point in the physics course. But small points have a habit of giving great trouble. If this suggested substitute is a real improvement, it should be adopted. Not being a teacher, I may fail to see teaching flaws in my proposal; or it may not be a sufficient simplification to warrant changing our texts and methods. Therefore I leave the question with my physics teachers curious enough to try the method with their classes. Any results and comments will certainly be welcome.

Fig. 3. A magnetic field curls about the conductor in the direction of the fingers.



Science for Society

EDITED BY JOSEPH SINGERMAN

• A department in which science is presented in its close relationship to the individual and in which guidance is given in causing the individual to recognize the methods of science and its vast social implications.

Science in the U.S.S.R.

*In their blood they are building
a new world.* PAUL ROBESON

"Why didn't we know before now about these stalwart youth and valient friends in Russia?" This challenge from the lips of twenty year old John Darr, Jr., a student at Union Theological Seminary, fell as a bombshell upon a recent gathering of people vitally interested in education. It was not Darr calling his educators to account; it was the voice of an ever increasing number of American youth.

IT HAPPENED at the Education Panel on the occasion of the 1943 Congress of American Soviet Friendship. Leaders in American education paid high tribute to Soviet education. Groups of eminent American scientists and medical men, comprising other panels in the Congress, paid equally high tribute to the high caliber of Russian science.

Speaker after speaker expressed nothing but the highest praise for practices in the realm of Soviet education, and related almost unbelievable accomplishments in specialized fields of science and medicine. In thus recognizing the achievements of the foreign scientists, and by their demonstrated readiness for self criticism, these groups of Nobel Prize winners, distinguished scientists and leading doctors, inadvertently paid tribute to a foundation stone of American democratic spirit itself.

IN POINTING out how "American democracy depends on education," Dr. Donald DuShane, of the National Education Association, said, "... it might be expected that, at the inception of our government, provision would be made for a nationwide system of mass education, either by the Federal Government or by the states. Yet no such provisions were made and the early development of our edu-

cational system was left largely to chance as far as the Federal Government was concerned."

The Science Panel was led by Nobel Prize winner Professor Harold C. Urey. What better evidence could be afforded of the soundness of the Soviet policy of education than the tangible results in fields of scientific endeavor, which must of necessity rest upon a solid foundation of learning? "The great vitality of Soviet biology", said Dr. L. C. Dunn, leading American geneticist and Columbia Professor of Zoology, "Here there is no doubt that the most important contributions have been coming from the USA and the USSR, and in number of workers, of institutes and in quality of work these two countries are comparable . . . By 1940, Moscow had in fact become one of the most important centers of genetics in the world."

MANY SMILES and noddings of the head among those at the speakers table were precipitated when, in the discussion period, Dr. Conklin, Professor Emeritus of Princeton, added that the Soviet Union had printed over three times the number of volumes of his book than was published in the United States. Dr. Dunn remarked that as against 2,000 copies of a certain standard American science text, 15,000 were issued in the USSR.

Dr. V. K. Zworykin, R.C.A. Laboratories Research Director, pointed out that "Important recent advances in the field of electronics originated in the Soviet Union, the work of Mandelstein and Papalexy, for example, on the theory of non-linear phenomena in electronic circuits. The technique of high frequency heating of metals and dielectrics was not only originated in the Soviet Union but was first used there on a large scale particu-

larly for hardening of transmission gears and cylinders in aviation engines."

IT IS OBVIOUS that Russia is reaping the benefit of sound educational policy resting on the firmness of a basically democratic social bedrock. Dr. John W. Somerville of Hunter College pointed out that the Soviet Union has been the first nation to offer higher education to all people regardless of economic status, not merely free of charge, but allowing a stipend to provide for general living expenses. This is the first country in the history of civilization to make segregation or restriction on the basis of race or color a criminal offense. There is no chronic unemployment, with assurance of employment in the field for which the individual is trained. Were it otherwise, would not their extensive educational program have been a poor economic investment? Somerville referred to a "scientific" treatise published in 1938 by a Nazi leader, entitled, "Woman, Is She a Human Being?" The writer's conclusion was that woman is an "intermediate between ape and man." The soundness in opening all educational opportunities to Russia's women is proven by the eminent success of many women in every field of technical endeavor. In twenty six years, through famine and want, some 180,000,000 people, inhabiting one sixth the area of the earth, have elevated themselves from a condition of 80-90% illiteracy to 80-90% literacy, with a functioning technological development equal to the exigencies of the times.

"No country has been more written about and talked about in America during the last twenty five years than the Soviet Union," said Professor Ernest J. Simmons of Cornell University, "But the vast body of this material has consisted so often of misinformation or half-truths, and, occasionally, forthright lies." One of the impressions widespread was that science could not progress under their social system. Yet, "The progress of biological research in the Soviet Union," said Dr. Dunn, "has taught us a very valuable lesson. It is that control and organization of science by and for the whole community does not kill the scientific spirit or initiative nor submerge

the individual scientist in a dead level of anonymity. Great individuals have arisen in Soviet biology, fine discoveries have been made and continue to be made even in the midst of a war of which we in America have not yet grasped the scope or the full meaning."

IN REFERRING to their program for the full utilization of natural resources that would make possible a higher standard of living for the people, Dr. Carl O. Dunbar, Director of the Peabody Museum at Yale University, remarked, "It is remarkable that it has been planned on a broad basis with provision for many researches in pure science that will pay dividends only in a long-term program. This has been done in spite of the urgency of time and the imminent threat of outside attack. Even now, while such heroic sacrifices are being made to fight a total war, a steady stream of research and publication is appearing in geology and mineralogy."

"The Institute of Experimental Medicine," reported Dr. Selman Waksman, Professor of Microbiology at Rutgers, "became a center of some of the most brilliant work in the various branches of this science . . . The Revolution of 1917-18 was followed by a tremendous development in the various fields of bacteriology . . . Industrial microbiology reached a high state of development in Russia never dreamt of before." He went on to quote the brilliant and venerable Soviet biochemist Bach: "It would be a mistake to think that, in setting itself practical aims, science in the U.S.S.R. neglects the solution of theoretical problems; quite the contrary is true. Soviet scientists strike for a happy combination of theory and practice and for their interaction."

FAMED Arctic explorer, Sir Hubert Wilkins, paid high tribute to Soviet exploration. "In recent years," he said, "Soviet explorers have been especially active. I venture to say that in no other country has exploration and the exploitation of the results of exploration been more energetically and expertly developed and applied than it has been the Soviet Union. . . . The Russians have done more toward the development and exploitation of their Arctic lands and waters than has either the

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Importance of Insects in War Time

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[CONTINUED FROM OCTOBER ISSUE]

ONE of the most injurious and insidious insects, which is widespread and well established in this area and all over the country except the most northern states, is the subterranean termite. These creatures have the remarkable ability to live upon dead, dry wood and all products made of wood-pulp, such as papers, boxes, books, and fibre-boards. They are often improperly called "white ants," because the destructive worker caste is white and of the general size and shape of the more familiar ants. Termites in every stage can be distinguished from ants by the fact that they are always thick-waisted, while the ants have a pronounced constriction or thin "waist" between the middle part of the body and the rest of the abdomen. The termites resemble ants in that they live in great colonies or nests, which have a large force of workers that forage out from the home nest to find and devour food and carry a supply of it back to the nest to feed the young and the queens, which never leave the nest in the ground after they have started it. It is also very significant that the workers in both cases rarely lay eggs or have any offspring, but devote their lives to taking care of the enormous number of offspring produced by the few queens, which are veritable egg-laying machines. Consequently it does very little good to kill the ants or termites which we see in houses, because the queens can produce reinforcements faster than we can kill them.

A very important difference between ants and termites is that the ants forage out in the open air and sunshine and all over premises where they can easily be seen. But the termites live in a completely closed system of underground tunnels and burrows, which extend all through the soil and upward into our buildings. They may eat out all of the interior of timbers without showing any evidence of their presence on the surface, leaving a complete thin veneer to protect them from

the air and conceal their damage. Cases have been known where families have gone away on vacation, without any suspicion that termites were present in their houses, and have returned to find the grand piano or the kitchen stove in the basement; because the termites had so hollowed out the flooring, sills and joists that they collapsed completely under the weight of the furniture.

AN INDICATION of a serious invasion by termites, that occurs every summer in many buildings in this area, is the appearance inside the building of black, winged, ant-like creatures, with thick waists, which often come out of small holes in the floors, baseboards, window- or door-frames and tend to accumulate on window sills, trying to get out of that building to start new colonies. If the windows are closed they will often break off their milky white wings and leave them there, after they have crawled away. These winged termites can be distinguished from the much less dangerous winged true ants, by their thick waists and the fact that their four wings are all of the same size; whereas the flying true ants have slender waists and their front wings are several times as large as the hind pair.

The black, flying termites, as in the ants, are the new functional males and females, which break out of the underground nests or infested timbers in summer, take a single flight, during which they find mates, and then settle down in the soil, break off their wings, and start laying eggs, which develop into the white, wingless, non-reproductive workers, that tunnel all through the soil, seeking some wood that is in contact with the ground, which they immediately begin to hollow out and devour. Winged termites do not usually appear in a house until that building has been invaded by the wood-eating, white workers for several years; so that their appearance is an almost positive warning of an extensive infestation of the building.

ONE OF the contributions home owners should make to the conservation of our resources, especially in war times, is to make a thorough examination, at frequent intervals, of the foundations of all buildings, both outside and in, for evidence of these very prevalent, silent, hidden and insidious wood-destroyers and stop the invasions before they become serious. Owners should periodically examine all wooden buildings, especially dark places inside the basement, looking for the characteristic shelter-tubes, which the pests build of soil, pulverized wood and excrement, to make covered runways over bricks, stones, concrete, or iron pipes, which they cannot eat through, leading from the soil below to the wood above. These shelter-tubes vary from the diameter of a lead pencil to an inch or two across and may be several feet long. The lowermost timbers of buildings should also be examined by pounding lightly with a hammer and listening for the characteristic hollow sound, where the interior of the wood has been hollowed out. Or a sharp instrument, such as an ice-pick, may be used to detect infested timbers. It will readily penetrate the thin, veneer-like, outer shell always left by termites to conceal their tunnels in the wood. There are also pest control companies operating in most communities who will make such examinations.

An infested building will usually require the services of an honest, reliable, professional pest control operator or insect exterminating company. But there is much that the home owner can do to prevent these insects from getting started in his buildings. The most important thing is to make sure that not a single bit of the wood is in contact with the soil. *Guard the danger line*, such as basement window frames, cellar steps, porch steps and lattice work, or sills and siding that extend down to within a few inches of the soil. Stringers for basement stairways and other supporting timbers are often built down to the soil and the concrete basement floor poured around them, which is a most dangerous practice. A single 2x4 timber leading from the soil to the framework above may serve as a point of entrance for thousands of

termites that will ruin the foundation of a large building. Such supporting timbers, porch steps and the like should always have a base of solid concrete or stone, at least eight or ten inches high, between the wood and the soil.

THE USE of termite shields of sheet metal, extending all around the building and separating every bit of timber from the masonry below and projecting two or three inches into the air, both outside and inside the wall; such shields, if properly installed by an expert who thoroughly understands the termite problem, are one of the most thoroughly effective methods of providing permanent protection. Poisoning the soil about the basement wall, down to the level of the cellar floor, is a very effective method of keeping these pests from attacking, but also requires the services of a professional insect control operator.

The wise home owner will get rid of all waste wood about his premises and not allow piles of firewood, boards and posts to lie long in contact with the soil, since this is inviting the termites to establish colonies, from which they will surely, sooner or later, invade his buildings. Such wood should be stacked upon stone, brick or concrete blocks that keep it away from the soil and so will not be tempting to these soil-inhabiting wood-eaters. Posts and other pieces of wood that *must* be placed in the soil should be rendered termite proof by thorough saturation with creosote, zinc chloride solution or other termite-proofing chemicals.

A pernicious habit when constructing a new frame building is to allow waste scraps of wood and shavings to drop down between the excavation and the outside of the foundation wall and later be covered with soil, thus providing a paradise to attract termites right against your new house and supply them with enough wood so that they can build up a powerful colony, which will then eat up the house with irresistible persistence and cunning.

Another group of wood-eaters that often destroy the interior of sills, joists, sub-flooring and rafters, and that are very destructive to stores of lumber, such as are used for making gun stocks, airplanes, tool handles, the spokes

of wooden wheels and furniture are the powder post beetles. When these pests are present, flour-like, powdered wood, which has passed through the bodies of the grubs or larvae, will usually be noticed sifting out of the infested furniture or timbers, especially when they are moved or jarred. The powder post beetles differ from termites and termite attack in a number of important respects: If timbers infested by powder post beetles are cut open, the interior will usually be found packed solid full of the extremely fine dry dust made by the grubs pulverizing the wood. If abundant the whole sill or joist may have been converted to powder, except a thin outer shell which is not devoured and holds the timber in shape, concealing the damage, until it collapses entirely due to the weight it supports. Termite-infested timbers, on the other hand, have empty tunnels throughout the interior, from which the worker termites have eaten out the wood fiber or carried it back to their underground nest to feed the young and the queens. Sooner or later in powder post-infested timbers, many tiny round holes will be made to the outer surface through this veneer, so that the adult beetles can escape—the whole block of wood looking as though it had been riddled with holes from a shotgun loaded with fine bird shot. Termite infested timbers never show many holes on the surface, all the adults emerging from one or a few spots, which are immediately sealed shut again.

In powder post-infested timbers will be found small, thick-headed, white-bodied, curled grubs or larvae, that crawl very slowly; or the small, hard-shelled, slender, reddish-brown to black, parent beetles, less than a quarter inch long, instead of the active, running, white workers of the termites.

AN IMPORTANT difference from termites is that the powder post beetles do not enter the wood from the soil, as the termites always do, but fly about in buildings and lumber yards and lay their eggs in pores in the wood, from which the grubs hatch and bore directly into the exposed surfaces of the wood. Furthermore, they do not have to maintain contact with the soil, as the termites must;

but can live and burrow for years in the dry timbers of a house or barn without any contact with the soil.

Powder post beetles may be introduced and established in a new building by the purchase and use of lumber infested in the lumber yards; but this never happens with termites, for they cannot maintain themselves without continual contact with the home nest; and that is always in the soil in termites that are found in this part of the country. For the same reason, termites kept isolated from the soil by termite shields will soon perish without doing further damage; but that will not have any effect upon powder post beetles. Lumber used in constructing a new building should be carefully inspected for evidence of these pests in the form of tell-tale powdery dust sifting out of new holes in the wood. The basement timbers of old buildings and furniture may also show these symptoms of attack, before the numerous little round holes made by the emerging adults become plentiful.

If infestations in structural timbers are discovered, before the attack has weakened them so that they are no longer safe or serviceable, the insects may be destroyed by surface applications of such chemicals as oil extracts of pyrethrum, or orthodichlorobenzene or chloropicrin, applied to cloth fastened over the surface of the timbers. The use of the latter two chemicals requires very careful handling and precautions to avoid injury to the eyes, respiratory passages or skin of the operator and occupants of the building. Furniture and woodwork in an infested building may be protected from attack, by finishing all surfaces with paint or varnish, which repels the beetles from laying eggs and infesting the wood.

BESIDES the fabric and wood-destroying pests, a third very serious group of stored product insects includes the moths, beetles and weevils that eat seeds, flour, meal, bran, cakes, crackers, poultry- and dog-feeds, and all other products made from seeds; as well as nuts, dried fruits, tobacco, and nearly every kind of drugs and dried plant products. Food is even more essential to our existence than clothing or houses, so these food destroy-

ing pests are very serious enemies. Some of the cereal insects develop entirely inside of single seeds, eating only the interior of the seed, and so they cannot be seen until they emerge as adults to seek other seeds upon which to lay their eggs. They attack whole grains in farm granaries, in the ever-normal government granaries, in mills, warehouses, seed stores, groceries, feed stores, kitchens, pantries, and every other place where seeds are stored. Other kinds roam about among seeds, flour and meal and feed externally. These are easily observed among the surface layers of grain or other products, and flying about in the granary, storeroom or house.

At least a dozen kinds of beetles, ranging in size from less than one-tenth inch to more than an inch long, 4 or 5 species of moth caterpillars, and several kinds of grain mites are prevalent in this area. Peas, beans and other legume seeds are heavily attacked by weevils of different species, which enter the seeds as very minute larvae, while they are growing in our gardens. They are placed unnoticed in the stored seeds where they complete their feeding and growth and, in the case of the common bean weevil, produce additional generations in storage as long as any seeds remain for them to attack.

How very serious such pests may be in war time was well demonstrated during the first World War. At a time when the continued resistance of the British to the Germans depended, more than anything else, upon whether another boatload of food could reach the British Isles, infestations of cereal insects were discovered in dangerous abundance in the precious stores of wheat in Australia. No time was lost in dispatching the most able British entomologists to Australia to check the infestations at all costs.

During the past several years, since the home loan-granary program has been in force, wheat and corn arriving at the markets from farm storage has been the worst infested in twenty years. About one-third of the wheat reaching market two years ago was found to be infested with grain insects, and from 12 to 20 per cent was so badly damaged that the buyers refused to grade it at all. That is

exactly what every well-informed entomologist predicted would happen, when the long-time, farm storage of grains was first proposed. The average farm is not properly equipped to keep seeds in storage safe from destruction by insects; and whenever such storage is undertaken throughout the summer, the grains and seeds are almost certain to suffer heavy damage. The recent program of cleaning corn, stored in government granaries frequently, to check the damage has reduced infestations. The safest and cheapest plan in the long run, will be to concentrate grains for long-time storage, in large, well-equipped elevators, where they will be under frequent inspection by well-trained men, and where effective control measures can be applied at the first signs of infestation.

THESE grain insects may infest the seeds of plants at any time and place, from the time they are growing in the field, or as soon as they are harvested, until they have been utilized by the ultimate consumer. They may first attack the grain while it is in the farm barns, cribs or granaries; at the elevators awaiting shipment to the mills; at the flour mills and factories where cereal products are produced; in freight cars that have previously handled infested grain and have not been properly cleaned; in warehouses after milling; in wholesale houses; in retail stores; or in the home kitchen or pantry. If the insects are kept from getting into the material and laying their eggs during all of these steps in the harvesting, storing, shipping, milling, and redistributing of the products, there will be no loss from insect attack. But carelessness at any one of these steps will undo the care exercised at all of the others.

There are some very effective fumigants that may be used to destroy the insects in grains without injury to the products for food or even to seeds for planting, if they are stored in tightly constructed bins. Superheating to 125 to 135 degrees Fahrenheit may also be used. A simple method recommended for small quantities of seeds to be used for planting is to place them in a bag in a kettle of cold water and gradually heating the water to 140 degrees Fahrenheit, then pouring the

seeds out on some surface where they will dry out.

A fourth distinct group of stored-product pests includes those which eat meats, cheese and other substances rich in proteins and fats. Stored meats, hams, bacon, dried beef, dried egg products, evaporated milk and cheeses of all kinds are commonly riddled and ruined by several kinds of beetles, by the maggots of the cheese-skipper fly, and by a number of kinds of mites so small that they are barely visible to the naked eye. I have known of several cases where people become very enthusiastic about the unusual flavor of a particular lot of cheese, only to find out, later, that the flavor they thought they liked was due to the presence of thousands of these tiny cheese mites. Then their enthusiasm invariably faded rapidly.

MECCHANICAL exclusion of these pests of meats and cheese is the simplest control. Smoked or dried meats, hams, shoulders, bacon, and cheese stored on the farm, should be protected promptly, before placing in storage, by being wrapped very thoroughly in tough paper or close-meshed cloth, making sure that no cracks or openings are left, through which the beetles, mites or their tiny, newly-hatched larvae can gain access to the products. Cheeses may be protected by coating them completely with paraffine.

Wherever available, storage in community refrigerators completely prevents injury by this group of pests, as no household insect can feed or grow at temperatures below 40 degrees Fahr. Fabrics can also be protected from clothes moths and carpet beetles by placing winter garments in cold storage during the summer months. Even if infested, when put in storage, the insects can do no further damage so long as the proper temperature (40° F.) is maintained.

Long storage of all consumable products should be avoided, if possible. Many of the food-infesting insects may complete a generation in six weeks or less, and each female may produce from 100 to 500 or more offspring. If unattacked by man or another of their enemies, a single female grain insect introduced to your kitchen or factory or storeroom in April, may by October be great-great-great

grandmother of over sixty billion of the grain-devouring pests. Wholesalers and retailers should see that the oldest supplies are kept moving out first, so that no stocks are kept an undue length of time. Elevator operators and manufacturers should watch all incoming grains to see that they are not infested with these destructive insects. Many manufacturers of cereals, candies and tobacco products regularly practice vacuum-vault fumigation of the packaged materials just before they leave their factories, to make sure that they are free from these pests or their eggs.

IN CONSTRUCTING storerooms, bins and granaries for the storage of food products great care should be taken to make the sides and bottoms as nearly air-tight as possible; so that if they become infested they can be effectively fumigated. Another point of great importance is to store all such products in places where they will be kept as dry as possible. Granaries and storerooms should be remote from moist soil. A second-floor or attic room is much better than the ground floor or basement. Most grain-eating insects thrive best—and in some cases, only—in grain and grain products that are very moist. Newly harvested seeds should not be stored while excessively moist. Most such pests do not multiply at all in materials that have a moisture content of less than 10%. Dampness also favors attack and damage by clothes moths; and a constantly wet basement wall, due to poorly constructed drains or leaky faucets, is a powerful inducement for termites to attack and eat up the wood of a house.

A third very important point in construction of granaries and storage houses, as well as dwellings, is to do away with all unnecessary cracks and crevices, in which many kinds of grain-eating insects may remain hiding from one year to the next to attack the new crop of grain; and in which many of our worst household pests hide during the daytime and from which they forage out at night to explore, eat and contaminate our possessions. There are excellent crack-filling compounds that can be used to seal up these hiding and egg-laying crevices and so make the eradication of the pests much easier.

ANOTHER very important method of avoiding the attacks of many household and stored product pests is extreme cleanliness. A little grain left in cracks in a granary floor when the grain is marketed, may enable grain insects to hold over *for an entire year* until the new crop is placed in the bins. Clothes moths prefer to feed upon dirty, grease-spotted garments, which adds something to their monotonous diet of keratin. Scraps of food, crumbs, greasy or sugary utensils allowed to remain in, or close around dwellings are extremely attractive to cockroaches and ants. All food products should be securely enclosed in refrigerators, ovens, tight drawers, cabinets or cans; or in unbroken, tightly sealed cartons. Fabric bags with paper linings, closed with a strip of rubber latex tape are proof against nearly all insects, except the cadelle which will eat through cloth or paper to get at its food.

On farms sacks are a prolific means of spreading grain-infesting insects. They should be superheated or fumigated before using them to handle a new crop. Animal feeds are often badly infested with these pests when sold and delivered. If brought to a farm in such feeds, the pests may spread to granaries, kitchens and storerooms and cause trouble for years. The purchase of second-hand furniture is often the cause of introducing clothes moths, carpet beetles or towbugs to a home.

Avoiding long storage, unusual moisture, and keeping all places where products are stored, as tight, as free from cracks, and as clean as possible, will prevent a large percentage of the devastating attacks of fabric- food- and other stored products pests.

THE FINAL group of household insects, whose fifth-column activities I would like to expose and help to check, are those which invade our houses, stores, hotels, hospitals, restaurants, and public buildings, roaming about all over the place and eating almost anything they can find.

First, there are the house ants, one of the most common and annoying groups of pests. They really do relatively little direct damage and they are so clean that they are not a serious menace as disease carriers. Their

damage may be said to be largely psychological. They get into everything and crawl over every thing, and for every one the harassed housewife kills, it seems as though a dozen come to the funeral, from the prolific egg-laying queens in the underground nest out of doors or in the basement walls. Since the ones that invade our houses are never parents, it does relatively little good to kill them. It would be almost like trying to dip water out of a swift stream in order to get across without wetting your feet. The prolific queens provide the stream of worker ants. Sometimes, by scattering powdered sodium fluoride or fresh pyrethrum powder around in all of the places where the ants are seen, they can be scared away and will transfer their attacks and nests to your neighbors' property; but that is not a very high-grade or lasting control.

THE SECRET of thorough ant control is to destroy the egg-laying queens, which never leave their nests in the ground. If the queens are killed, all wandering workers will soon die off, for they cannot maintain their colony or start new colonies without their mothers—the queens. A little back-tracking of the trails of ants, which follow each other from nest to food and back to the nest, like a string of geese, will often enable one to locate the nest in the ground. Whenever you find a place where the ants descend into the soil or from which they are “boiling up” out of the soil, punch a few holes into the ground around that point, 4 to 12 inches deep and, with the aid of a funnel, pour into each hole a few tablespoonfulls of carbon bisulphide liquid, or calcium cyanide dust, and promptly close the holes with moist soil. These chemicals each forms a very deadly gas that will penetrate all through the soil, if it is fairly dry and warm, and kill all stages of the ants, including the queens. Don't use carbon disulphide while smoking or anywhere near a fire, flame or spark of any sort, as it is very inflammable. And, in using the calcium cyanide, be very careful not to breathe the deadly fumes given off from the tins in which it is sold, when they are opened.

If you cannot locate the nests, the queens

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Science Clubs at Work

State Teachers College

Edited by DR. ANNA A. SCHNIEB

Richmond, Kentucky

• A department devoted to the recognition of the splendid work being done by the science club members and their sponsors in the various State Junior Academies of Science. Material for this department, such as student made projects; demonstrations and posters; outstanding club programs; state and regional meeting announcements; should be sent to Dr. Schnieb.

Virginia Junior Academy of Science

HUBERT J. DAVIS

Chairman, Junior Academy Committee

Williamsburg, Virginia

THE VIRGINIA Junior Academy of Science is a part of the Virginia Academy of Science. Its main objective is to stimulate more interest in science in the secondary schools through science club work. It assists the high school science teachers by providing new ideas, supplementary teaching materials, and motivation through science congresses, competitive radio programs, and science exhibits. Recently it has inaugurated a search to discover pupils with scientific abilities to guide them in selecting work which will lead to a scientific career.

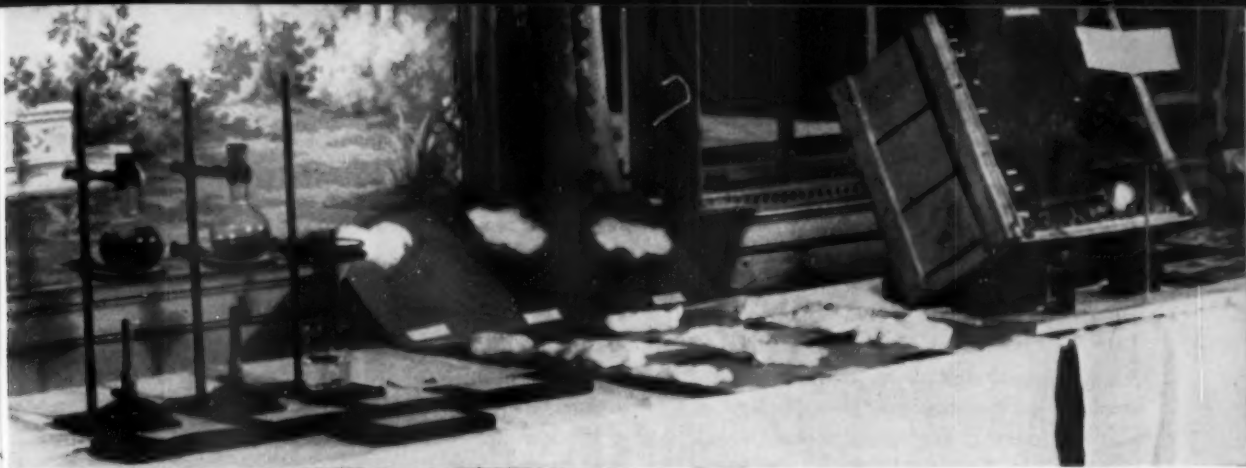
The Junior Academy of Science was conceived and organized largely through the efforts of the Virginia Academy of Science committee on "the place of science in the high schools", under the able leadership of Loyd C. Bird. The American Association for the Advancement of Science held its annual meeting in Richmond in 1938. At this meeting the council pointed out the possibilities of science club work to the committee. This was the first move toward organizing a junior academy of

science. Next the science teachers of the state were interested and their support enlisted. To do this, the committee secured Dr. H. H. Sheldon, director of the American Institute of Science and Engineering Clubs of the City of New York, as the chief speaker for the science sections of the Virginia Education Association in November 1939. Later, Dr. George W. Jeffers, president-elect of the Virginia Academy of Science, spoke on the science club movement in Virginia over radio station WRVA Richmond. That these speeches aroused widespread interest was revealed through a survey of the state conducted by the state department of education. It found sixty science clubs well scattered over the state.

THE INTEREST in science clubs continued to grow as the school year progressed. In May 1940 Mr. Bird's committee invited the sponsors of the science clubs to send delegates to Lexington to meet with the Virginia Academy of Science and to discuss the possibilities of organizing a junior academy of science.

Below: The first student officers of the Virginia Junior Academy of Science. From right to left, Catherine Christian, Secy., Appomattox; A. J. Davis, Pres., Danville; Patsy Whitaker, V. Pres., Pulaski.





Above: Part of the Junior Academy of Science exhibit held in Roanoke.

More than fifty—delegates and sponsors attended this meeting. Dr. Otis W. Caldwell, general secretary of the American Association for the Advancement of Science, attended and presented the request of the sponsors to the academy for authority to organize a junior division. This permission was promptly granted. In June the president, Dean Wortley F. Rudd, selected the personnel for two committees to organize and to sponsor the junior academy. The organization committee was composed of science club sponsors, and the sponsoring committee was selected from members of the Virginia Academy of Science. These committees prepared for the first meeting of the club delegates, assisted in the selection of student officers, and in the drafting of a constitution.

The first convention of the student delegates was held in conjunction with the Virginia Academy of Science in Richmond, in May 1941. As a special attraction for the junior members, the General Electric *HOUSE OF MAGIC* was obtained for the meeting. Four hundred-fifty pupils and science club sponsors attended this meeting.

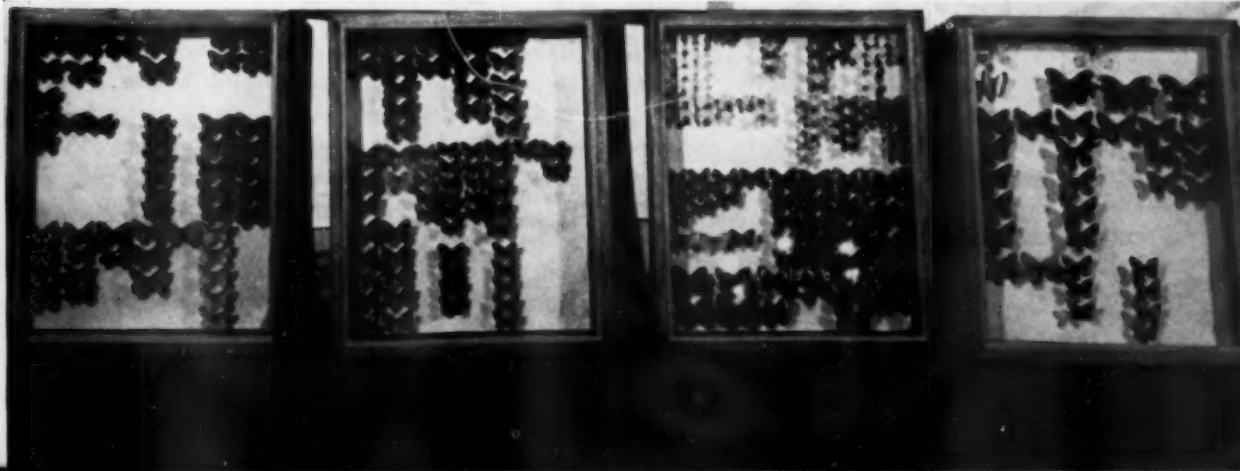
The accomplishments of this convention of high school delegates would challenge the standards of most adult groups. During the morning they participated in a science exhibit, a competitive radio quiz, provided a speaker for one section of the adult group. At their business meeting in the afternoon their committees presented reports, they drafted and adopted a constitution, elected student officers, and ratified an affiliation of the junior academy of science with the American Institutes of Science and Engineering Clubs.

MANY of these delegates received recognition from the Virginia Academy of Science for outstanding achievements. Prizes were awarded for winners in the science exhibit and the radio quiz. Two pupils were awarded honorary memberships in the American Association for the Advancement of Science. Three similar memberships were awarded in the Virginia Academy of Science.

This initial meeting of the delegates of the Junior Academy of Science provided an impetus for the organization of science clubs

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Below: Part of a butterfly exhibit by Sarl Gottschalf at the Roanoke meeting.



Science Training in War Time

TRAYER C. SUTTON

Cass Technical High School

Detroit, Michigan

THE IMPRESSIVE program of science training, necessitated by the demands of war, has been a success because the average science teacher, during the past twenty years, has insisted upon doing a fairly good job teaching the basic high school science courses.

War creates many unusual needs—needs which must be immediately satisfied. It is in the fields of scientific research that the most important needs are located. There is intensive research into transportation, into radio, into general communications, into aeronautics, into agriculture, into nursing, into medicine, into nutrition, into explosives, etc. Science has developed and improved methods used in destructive offensive warfare. It has not only worked out methods of destruction but also methods for preserving and protecting human lives. It has constantly built and bettered machines—in fact it has helped in the creating and developing an untold number of usable things.

In this war our government has had many difficult problems to solve—and in nearly every case it has been the scientist, with his applications of scientific methods, who has provided the workable solutions. War always demands that the efforts of the enemy not only be met but be surpassed. This has been done. These pressure demands bring about important by-product discoveries—not fully developed—which in peace time will be of value. These pressure conditions have caused the scientist to bring together and organize scientific knowledge so that the war may be more quickly won. This is the contribution that is being made by the trained scientist.

EVEN during peace times industry has become so complex that a person must study with diligence in order to understand its most basic requirements. When the war started, and the demands of industry for trained men and women in the science fields became pressing, there were many apparently intelligent persons who seriously and sincerely proposed

that the shortage could be filled by teaching a large number of selected persons a few basic scientific rules. This was to be the method of solving this problem. Science teachers have been looking for these *few basic scientific rules* for many long years—and they are pretty sure that they do not exist. This is a fact.

On the outbreak of the present conflict technical education did hear appeal from all sides, from the army, from the navy, from government officials, for an increased number of scientifically trained persons. At their own level the technical high schools have attempted to meet this demand.

THIS demand insisted that there be immediate action, with the expectation that the schools could at once turn out a finished product in the form of competent, scientific, and technically trained persons. True educators in the field of technical work knew that the demand could not be met at once. Time was required.

Technical secondary school instructors have always had faith in the ideal of well taught fundamentals. They have always believed that a thorough knowledge of the basic sciences was necessary if an individual was to be considered technically trained. Because they possessed the facts, science teachers, when the war arrived, at once understood the problem and the need for more training in the actual sciences—and in mathematics.

AT THE beginning of the conflict there were many sincere individuals who believed the solution, for obtaining a large number of persons possessed of technical training, was to be found in hastily organized short science courses. These were to be known as specialized courses. In some miraculous manner, these hastily organized courses, were supposed to prepare high school students for complicated technical work in the armed forces. The majority of persons who support-

ed this plan were not trained in the sciences or in mathematics—and thus did not understand the requirements to be met in order that a person well trained in the sciences might be produced. Some of these advocates believed that abbreviated and condensed courses in Physics and Chemistry could be substituted for the standard courses. They failed to recognize that these so called short specialized courses were being better taught and understood in the regular secondary school science classes than they could be taught in short, disjointed, and unrelated, specialized form. The armed forces have been offering short specialized courses—taught by experts—who know what the army wants taught; in the manner in which the army wants things taught. This type of course as taught by the army has been a success because it was based upon the assumption that the average high school student has had one or more standard courses in science.

There are many expressions to the effect that officials who must train men in the armed forces, in the majority of cases, prefer to have the candidates start from the beginning in specialized fields—having only the regular high school courses as a basis—rather than to have the recruit possessed of a smattering of disconnected specialized knowledge. Teachers are not army experts—and the highly technical and specialized army, air, and navy, knowledge which demands a familiarity with the changes taking place from day to day is not a part of their experience. How many teachers are in position to know about these constantly changing requirements? The short courses—of specialized character—taught by teachers not familiar with the actual needs frequently have to be unlearned by the student before the armed force experts are able to teach the things of usable value.

THE SO-CALLED conservative teachers—who are in many cases the most progressive—believe in teaching basic values. These teachers believe in the fundamentals because they have witnessed the priceless effects of such values upon the boys (who become men) in their struggle to attain worthy success in the technical fields—and because they have

watched time after time the failures of those who did not appreciate the values of well taught fundamentals. These teachers considered carefully the real and actual demands of the war, relative to the things to be done, in the terms of science—and decided that before any of the abbreviated or condensed, or specialized courses were offered there should come first sound and basic training in Chemistry, Physics, Biology—with plenty of real emphasis upon real Mathematics.

These honest and experienced instructors know that a boy with such a background could easily master the techniques and methods in the practical work of radio, aviation, navigation, etc., when the proper time arrived. With such a science background the student could take the specialized army and navy courses with true understanding—and possess to full the appreciation of the practical application of his knowledge. He would become useful at once—and there would be little waste time and effort.

Fortunately for America the technical high schools have not offered “soft” science courses. The basic subjects of Chemistry, Physics, Biology, and Mathematics have been taught—and thoroughly taught for years. These technical schools—this really means the instructors—have frequently, in the past, been made the objects of scorn by certain groups of modern educators, because they would not offer make believe, denatured, and easy courses in sciences and mathematics. The ideal of teaching well and thoroughly the basic sciences—and maintaining high scholastic standards has been, during this war, justified. These teachers have been justified if we are to believe the reports coming from the armed forces.

WE FEEL that there is a definite place in our curriculum for the so-called pre-induction courses. They are of true value if taken in addition to the regular standard science and mathematics courses. They should never be substituted for the regular science subjects. It is a known fact that the high school boys—now in the service—who have taken the regular high school sciences and then added certain pre-induction courses have given an excellent account of themselves.

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News and Announcements

PLANNING FOR NATIONAL COMMISSION CONTINUES

A RATHER detailed statement of specific proposals for a national commission on science teaching has been prepared and circulated for criticism and revision. A generous response to these proposals has been received and for the most part the responses indicate a very substantial interest in the plans. Statements such as the following indicate the points of view:

"I find myself favorable to most of the statements—you are undertaking an important job."

"The proposals—are excellent."

"Coordination, cooperative planning, and unification in thinking are all most needed as we look forward to the post-war period."

"My only criticism is that this organization should have been effected before this."

"It is extremely necessary that we work together in present and post-war planning in science education."

"The items in this proposal are carefully thought out and well worded."

EVEN more helpful than these statements were the specific proposals for revision. These suggestions are now being recognized in a revision which will be resubmitted to leaders for further study and criticism. Ratification by many organizations of science teachers will then make possible a vigorous national offensive for more and better science teaching in our schools.

It is hoped that a detailed statement of the proposals as revised by leaders in organizations of science teachers may appear in mid-winter numbers of several magazines. Your criticisms then will be appreciated.

Philip G. Johnson, Chairman
Planning Committee.

★

SCIENCE TALENT SEARCH

THE SCIENCE Talent Search, conducted by Science Clubs of America, is now under way

for 1943 and should be called to the attention of every senior boy and girl in science in the high school so they may have their chance to qualify for awards before the December 27 deadline. Whether a student is among the forty selected or not, the result of the effort is important in that it will stimulate many boys and girls to take more interest and do better work in science.

The objectives of the Science Talent Search, as outlined by Mr. Watson Davis, who is in charge of it, are:

1. To discover and foster the education of boys and girls whose scientific talent indicates potential creative ability and warrants scholarships for its development.

2. To focus the attention of large numbers of scientifically gifted youths on the need for perfecting scientific and research skill and knowledge so that they can increase their capacity for contributing to the task of winning the war and the peace to follow.

3. To help make the American public aware of the role of science in the war and the post-war reconstruction.

The students selected in the Science Talent Search receive Westinghouse Science Scholarships to help them in their further education.

★

RADIO AND TECHNICAL MERGER

After twelve highly successful years in the Radio book publishing business Alfred A. Ghirardi, internationally known author of some of the most highly regarded and widely used texts on radio theory, maintenance and repair, announces the purchase of his Radio & Technical Publishing Company by Farrar & Rinehart, Inc., Publishers, of 232 Madison Avenue, New York City, whose subsidiary the new Radio & Technical Division of Murray Hill Books, Inc. will continue to publish the present "Ghirardi" radio books as well as new ones that he will now have time to write.

Relieved from the exactions and many production and administrative details of running a publishing business, Mr. Ghirardi will now

be able to devote all of his time and energies to the writing of new books for the radio-electronic field, which lack of time has hitherto prohibited. He will also continue in close touch with the editorial phase of the business in his new post as Editorial Consultant in the field of Electronics for Farrar & Rinehart.

All orders for Ghirardi radio books should now be sent to Radio & Technical Division of Murray Hill Books, Inc., 232 Madison Avenue, New York 16, N. Y.

★

WRITE FOR IT

Science and the Future, a publication of Science Clubs of America. Write to Science Service, 1719 N Street, N. W., Washington, D. C. Free to science teachers, the booklet gives many essays written by prize winners of the Westinghouse Science Scholarship in the Second Annual Science Talent Search. It will help interest your students in trying for these awards and incidentally get them more interested in science.

★

New RMA Resistor-Condenser Color Code Wall Chart. Radio and Technical Publishing Company, 34 Astor Place, New York, N. Y. A completely new and timely compact color-code wall chart which presents in both pictorial and convenient tabular form the complete RMA resistor and condenser color codes. Issued in conjunction with the new revised and enlarged 3rd Edition of Radio Troubleshooter's Handbook by Alfred A. Ghirardi. The chart may be obtained free of charge by writing to the above company and enclosing a 3 cent stamp to cover postage. A 4-page folder describing the Handbook also may be had upon request.

★

Bibliography of Economic and Social Materials. March 1943 and later editions. The National Association of Manufacturers, 14 West 48th Street, New York. A 32 page booklet listing audio-visual material that may be used rent free, including a number of sound films, some of which are useful in science. Write to Mr. Henry E. Abt, Director, Group Cooperation Department.

SCIENCE IN U.S.S.R.

Continued from page 19

United States or Canada in their northern territories. And the developments that have taken place have been of great value to the Russians in relation to the present furious military struggle. . . . I am told that the charting of the coastal or near coastal waters of the Soviet Union's northern borders is almost as detailed as is the charting of our own eastern shores. This is an achievement of no small order for the charting of the Arctic seaboard is not a simple hydrographic matter."

Remarkable progress in the fields of public health, nutrition, medicine and surgery was amply illustrated by Drs. Walter B. Cannon, Abraham Stone, Hugh Cabot, C.E.A. Winslow, W. M. Stanley, Alice Hamilton and Wilder Penfield. In bringing the benefits of medical knowledge and skill within reach of the entire society, Russia is without question in advance of the United States. In the words of Professor Vladimir Lebedenko, U. S. Representative of the Red Cross and the Red Crescent of the U.S.S.R., "In the Soviet Union care for man has been transformed from an ideal into a law."

THE PEOPLE of the U.S.S.R. and the U.S.A.

I have much in common, spiritually and culturally, as well as in the physical nature of their respective lands. Charles E. Kellogg, Chief of the Division of Soil Survey of the United States Department of Agriculture, pointed out striking similarities of topography, soil and climate in the two nations. Marking the close of the New York Congress with a mass meeting at Madison Square Garden, 25,000 people listened spellbound as WPB chairman Donald M. Nelson told them of having noticed everywhere he went in Russia "strong similarities to America in attitudes and emotional drives of the people. Again and again I saw examples of the grim determination and a high spirit of a pioneering folk, like the American pioneers of whom we are so proud. . . . And I came away convinced that once we have come to know one another better and have surmounted the barrier of language, there will be found no two peoples anywhere in the

Continued on page 46

BITTER, SOUR AND SALTY

Continued from page 9

by courtesy. This earlier misuse can do doubt be traced to a belief that it is the Na^+ in NaOH which is responsible for the basic behavior. A perusal of Na^+ compounds will however reveal that only those are "basic" which contain one of the stronger of the Lewis bases. Similarly, the nitrate ion is often wrongly thought of as an acidic nature but only such nitrates as have a more or less strong "acid" cation have any acid tendencies whatever. All solutions containing H_3O^+ , Zn^{++} , Al^{+++} , etc., ions whatever the cation are acidic while those containing CN^- , $\text{C}_2\text{H}_3\text{O}_2^-$, $\text{SiO}_3^{=}$, $\text{S}^{=}$, SH^- , $\text{CO}_3^{=}$, and OH^- are distinctly basic and nearly all have the characteristic "freezing" action of bases for glass stoppers. The varying degrees of acidity in H_3O^+ ion solutions depend upon the strength of the Lewis base or an ion which has more or less counteracting effect upon the "acid."

Thus HOH is neutral because OH^- is a very strong base, $\text{HC}_2\text{H}_3\text{O}_2$ is weakly acidic because $\text{C}_2\text{H}_3\text{O}_2^-$ is a weaker base than OH^- (but rated as fairly strong) while HNO_3 is highly acidic because the NO_3^- base is one by courtesy only. It must be recalled, here, that a strong Lewis base is capable of furnishing a pair of electrons for a dative covalence with H^+ or other "acid" which results in a practically un-ionized molecule (which in its turn would be extremely weak acid.) A strong acid is one which belongs to a base that does not have this ability to form tightly-bound dative covalent unions.

THE PHENOMENON known as hydrolysis can easily be fitted into this treatment. Salts may roughly be divided into four classes upon the basis of their hydrolytic behavior. Class I including NaCl , KI , KNO_3 , etc. show no hydrolysis, i. e. have neither acid nor basic reaction. The Lewis Theory would point out that they consist only of the weakest acids and bases. (The Arrhenius Theory in contrast says that they belong to the strongest acids and bases.)

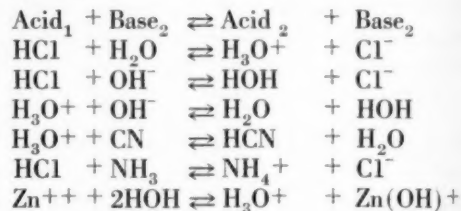
Class II including CuSO_4 , ZnCl_2 , alum, etc. show partial hydrolysis to an acidic solution.

This is due to their cations being fairly strong acids and their anions being of the very weakest bases. (The Arrhenius Theory would again turn this around to say that the cation belongs to weak base but the anion to a strong acid.)

Class III including KCN , Na_2CO_3 , $\text{NaC}_2\text{H}_3\text{O}_2$ show partial hydrolysis to a basic solution. This is due to their cations being of the very weakest acids but their anions very strong bases.

Class IV including Al_2S_3 , etc., show complete hydrolysis because the cation is a strong acid and the anion a strong base hence both are effective. (Arrhenius would say instead that they were from a weak base and a weak acid.) That is because the new theory looks at the strength from a different view point.

Nearly all chemical reactions except oxidation and reduction may be fitted into the following scheme:



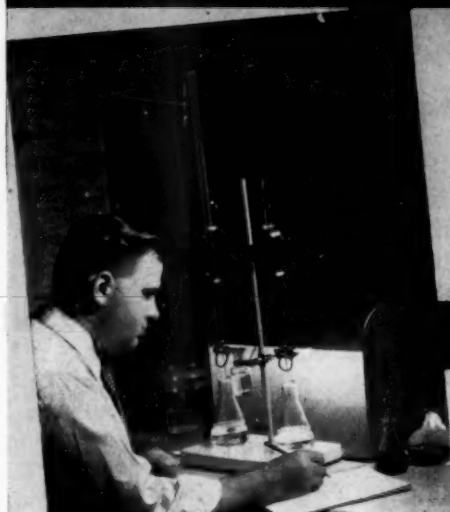
IT WILL be seen that only a few of these reactions could be called neutralization. Many of them are actually hydrolysis or solvolysis of some sort.

The word "salt" is to be restricted to a substance with an ionic lattice in the solid form and completely ionized when fused or dissolved. This definition would include Na^+Cl^- , Na^+OH^- , and $\text{H}_3\text{O}^+\text{Cl}^-$ but exclude Arrhenius salts like As_2S_3 , HgCl_2 , CdCl_2 , etc., which are practically unionized.

Admitting Na^+OH^- to the salt classification is not so unwarranted as it might seem as it has the same characteristics as other salts and is not more or much more basic than previously admitted salts like Na^+CN^- , $\text{Na}_3^+\text{PO}_4^{---}$ and Na^+HS^- . Acids, like HCl , HNO_3 , etc., are fundamentally different whether fused or dissolved and x-ray analysis has shown them to be ionized under all conditions, but the former must react with an ionizing solvent to become ionized:

Continued on page 40

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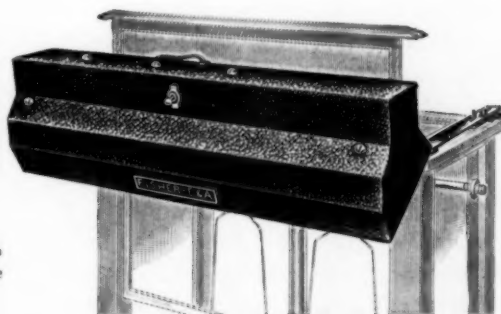
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VIRGINIA JUNIOR ACADEMY

Continued from page 27

throughout the state. A survey conducted before the close of the school year in 1941 revealed ninety-two science clubs representing about 2000 pupils. These clubs were dispersed throughout fifty-seven counties and seven cities.

The first year of science club work under the leadership of student officers was very successful. It was climaxed by a joint meeting of the Virginia Academy of Science and the Virginia Junior Academy at Roanoke in May 1942. The theme of the program for both academies was "*Science in National Defense*." Again the Junior Academy displayed an abundance of student talent. The highlights of this program were a science club exhibit, two radio programs, a lecture-demonstration on chemical warfare, an exhibit of model aeroplanes, and a butterfly exhibit.

THE SCIENCE club exhibits proved to be a special attraction for both academies.

It convinced many who may have doubted its value, that the science club held great potentialities for discovering and training high school pupils in real scientific pursuits.

The butterfly exhibit was, without a doubt, the finest piece of work ever exhibited by an amateur scientist in Virginia. This collection was made by Carl Gottschalk of Salem, Virginia. It consisted of more than 4000 different butterflies, including several hundred species gathered by correspondence from all parts of the world. Many of these were rare and valuable species. Through science club work, this boy became interested in entomology as a hobby several years ago. He pursued his hobby while in high school and continued it through college. At the time of this meeting he was considered the leading authority on butterflies in Virginia. As an undergraduate student he has been recognized by many of America's leading entomologists.

AT THE business meeting of the Junior Academy the delegates voted to affiliate with

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the Science Clubs of America. An arrangement was worked out through which the clubs, upon affiliation with the Junior Academy automatically become members of the Science Clubs of America. While the Junior Academy remains a distinct organization with its officers and functions unchanged, it provides also, the membership and prestige of affiliation with a national organization.

The fourth annual meeting of the Virginia Academy of Science was held in Richmond in 1943. Due to wartime restrictions on travel the attendance of delegates did not warrant holding a business meeting, nor electing new officers. The outstanding event of this meeting was the result of an act of the Virginia Academy of Science. It agreed to appoint a committee whose function would be to find pupils in science clubs with scientific ability, help guide them toward scientific vocations, and encourage them to remain in Virginia by obtaining for them worthwhile scholarships in Virginia Colleges.

THE VIRGINIA Junior Academy of Science has grown as the result of the efforts of many high school teachers, the leaders of the Virginia Academy of Science during the past five years, the interest and encouragement of Virginia's leading educators and scientists, and above all the faithful and untiring efforts of Dr. E. C. L. Miller, Secretary of the Virginia Academy of Science. All who have contributed to this movement can point with just pride to its achievements within the short time it has been in existence. Of course, the war has curtailed this movement. At present nearly one hundred clubs in Virginia are working on some type of wartime project to help speed up victory. Through the training now being given the youth of today in real scientific pursuits in the science clubs, these young scientists will be better prepared tomorrow to contribute to a lasting peace through applied science.

IMPORTANCE OF INSECTS

Continued from page 25

and the rest of the colony can be killed by the persistent use of a good poison bait exposed in cans with a few nail holes punched in their sides through which the ants can get to the poisoned food. The bait must be selected with reference to the food-preference of the particular kind of ant that is causing the trouble. If the ants are found in sugar, molasses, sweet cakes, and the like, a poisoned sugary or honey-solution should be used. If, on the other hand, the ants are feeding on meats, lard and other protein foods, the poison must be mixed in a fat, grease, or peanut butter, to attract that species.

The baits must be very carefully prepared so as to be attractive and not repellent to the ants. The poisons used must be slow-acting ones so that the workers which find them have plenty of time to carry some back to the nest and feed to the queens and the young, before they are overcome by the poison. Baits must contain a proper preservative, remain moist, and be renewed frequently until all ants have disappeared. We shall be glad to advise anyone troubled by these pests of suitable poisons if they will send us some specimens so that we may be sure what species is causing the trouble.

ANT WORKERS are active in the daytime and right out in the open; the other gypsy-like household pests are active at night or in dark places. Cockroaches may be present in a building by the thousands, and the occupants not realize that there is such a thing until they switch on a light in the kitchen, basement or storeroom, some night, and see them scurrying to cover by the hundreds. The majority of public buildings and dozens of homes, restaurants, bakeries and butcher shops and sometimes entire sewer systems in the cities and villages of this area are infested with roaches, unless regularly treated to destroy the pests.

Three conditions are very conducive to cockroach infestations: fairly high temperatures, considerable humidity, and some exposed food left by workmen eating their lunches, by food scattered by animals kept indoors,

or by careless housekeeping on dirty dishes or in exposed containers of any kind. Cockroaches are objectionable for several reasons. They are large and repulsive in appearance; they have a bad odor that clings to everything over which they run and is very hard to wash off of dishes and table service. When abundant and other food is scarce, they nibble at book bindings, photographs and cardboard containers to get the glue—often completely ruining valuable articles. And, crawling as they do, in dirty cracks, over walks, in toilets, privies and sewers, they are generally inexpressibly dirty. Their hairy bodies are admirably fitted to carry enormous numbers of germs and they may very well be responsible for spreading diarrheas, typhoid fever and tuberculosis.

AS IN the case of ants, it is important to know just which one of a half-dozen species of cockroaches common in buildings is present; for the control measures must vary somewhat with the different kinds. Important preventive measures for all of them are: First, scrupulous cleanliness so that scraps of food are not available, and covering of food supplies so that they cannot get into them. Second, guard against continual reinfestation from surrounding infested buildings or other reservoirs, such as sewers, wells and cisterns. All pipe lines should be very tightly sealed where they come through basement walls and floors, for the pests can squeeze through very narrow cracks and like to follow along moist pipe lines. All doors and windows, especially those near the ground level should be thoroughly screened, for roaches often swarm out of infested buildings at night and run along sidewalks or fly about and dodge into any available building. It is also advisable not to trade with stores located in tumble-down, poorly-constructed, unsanitary buildings and to watch carefully all deliveries of groceries, laundry and the like, among which the roaches are likely to hide while such goods are being delivered.

The most effective method of eradicating these pests is a thorough fumigation with hydrocyanic acid gas. Sodium fluoride powder, already recommended for poultry lice and ants



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is also a very effective remedy for cockroaches. It may be applied with a small hand duster or an electric power duster with a nozzle so constructed that the powder can be directed into all dry cracks and other hiding places about the entire house where the roaches congregate in the daytime, taking care that it is not dusted upon foods or dishes, or taken into the mouth by the operator or by children creeping over the floors. The dust should be left exposed, not taken up by vacuum cleaning, and applications repeated at intervals of 7 to 10 days until all signs of the pests have disappeared. If this poison cannot be used safely, fresh pyrethrum powder or a high-grade thiocyanate or pyrethrum household spray, applied by an electrically-driven duster or sprayer so as to penetrate into all cracks and crevices, will kill and stupefy all of the pests that are contacted by the dust or mist. Since some of those overcome by the pyrethrum may recover, it is well to sweep up and destroy all that can be found for several hours after these treatments.

High-grade, phosphorus pastes are excellent for the destruction of the American and Oriental cockroaches; but the little, tan, German roach will ordinarily not eat this poisoned bait. The pastes may be smeared over basement or sewer walls or in other out-of-the-way places; but in living quarters it is best to spread the paste over small rectangles of thin cardboard, about 4x12 inches, and then roll the cardboard into a cylinder an inch or less in diameter, with the paste on the inside and hold it together with rubber bands or string. These cylinders can be placed in any out-of-the-way place or tacked on the backs or bottoms of furniture, cupboards and the like. The roaches like the odor and taste of the phosphorus paste and they like to explore cavities, such as the inside of the cylinders, so that many will seek it out and be killed.

ANOTHER group of household pests, known variously as silverfish, fishmoths, firebrats, or slickers, have caused a great deal of trouble and damage in residences and public build-

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SCIEN

Continues

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ings in most localities, by roaming about at night and nibbling at books, card catalogues, wall paper, photographs, starched clothing and Rayon silks. They do not like paper, as termites do, nor fabrics, as clothes moths and carpet beetles do, but damage such articles in eating the glue, pastes and starch that are used in manufacturing the articles. Their habits are much like those of cockroaches and the control measures are similar. Pyrethrum dusts are considered better than sodium fluoride for silverfish; and a very different poisoned bait, made of pancake flour or finely ground oatmeal, seasoned with confectioner's sugar and finely powdered common salt, and poisoned with white arsenic or sodium fluosilicate, sprinkled among crumpled paper in open cardboard boxes, where the silverfish can easily get to it, is very useful in their control.



SCIENCE TRAINING

Continued from page 29

The technical schools have always been ready to accept new ideas provided they offer

a better way of doing the job. But to substitute untried ideas and plans in the place of methods known through experience to be workable and usable, during the time of war, seems silly. Science teachers are pretty sure that the well taught basic sciences make a worthy and real contribution to an effective defense of our national ideals.

When the war is over—and the story of the contributions of science can be told—the real value of good science teaching will be known. It has been well said: "It will include on account not only of unsurpassed research and development by individuals and cooperating groups, but also of valient service in the teaching of hundreds of thousands of service men in those fundamentals needed in the operation and maintenance of the many new devices, and in the technical procedures involved in aviation, navigation and gunnery. It will be an epic story of the preservation of a way of life of a free and democratic people."

Continued on page 43

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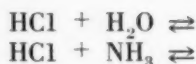
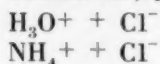
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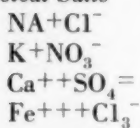
BITTER, SOUR AND SALTY

Continued from page 32

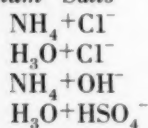


The following table shows a few of the new salts and the relation to the classical names:

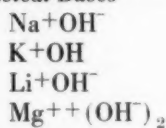
Classical Salts



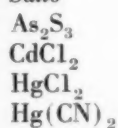
"Onium" Salts



Classical Bases



Not Salts



IT SHOULD now be clear that a salt is an electrically balanced combination (even a mixture if you will) of oppositely charged ions. A cation is usually an acid, although there are some few cation bases, like $\text{Zn}(\text{OH})^+$. An anion is usually a base although anions

like HSO_4^- are amphoteric. A un-ionized molecule may be either acid or basic depending upon whether it can accept an electron pair (acid) or furnish an electron pair (base) or it may be neither acid nor base if it does not possess one of these abilities.

1) How much of this should a High School Chemistry Teacher know? The writer would say that each teacher should familiarize himself with all the above material.

2) How much of this should be taught to the High School of beginning college student? Here, the answer would be that when the subject of acids, bases and salts comes up, the teacher should trace its development and point out the reasonableness of the modern concepts, giving the student thorough grounding in the differences in behavior between substances like HCl , NaCl and NaOH . Whenever it is convenient to do so the modern concept should be brought in until the student (and more important the teacher) can feel at least a little at home in both systems.

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CHEMISTRY IN COLLEGES

Continued from page 13

tory was counted as one credit. In physical chemistry four hours per week and in all others three, was the basis of evaluation.

THE QUESTIONNAIRE asked specifically about seven courses in chemistry and the results are shown in the next seven columns of Chart 1. Under the column "Other Advanced Courses" we find some of these schools offer up to 10 hours credit. These courses consist of Advanced Inorganic, Analytical, or Organic, Seminars, Research, etc. These were often not required for a major but the better students elected them even though in many instances only 40 hours could be counted toward a degree.

The column "Usual total for majors" lists from 32 to 47 credit hours and averages 40.4. It does not include biochemistry which is seldom taken by chemistry majors in these colleges.

Here I want to admit to a serious neglect on my part in that I did not ask specifically

about the requirement in mathematics and physics made of chemistry majors. Many of the teachers added it anyway and the results are shown under remarks. As might be expected mathematics through the calculus and one or more years in physics are usually required.

The rest of the charts are almost self-explanatory, except possibly in Chart 2 some numbers occur *between* the columns. This signifies the requirement is in one or both, or either, of the two. In making up the averages at the bottom of the columns these quantities were arbitrarily divided in half for each department.

At the bottom of Chart 1, there are recorded (after A.C.S.) the approximate number of hours credit suggested by the Committee of the American Chemical Society on "The Training of the Professional Chemist." In so far as course offerings is concerned, nearly all of these schools meet the requirements of this committee. Also there is shown, for comparison, a partial summary of an investigation of

407 colleges as reported in J. Chem. Ed. 16,575 (1939). The chief significant difference is in a slightly larger number of hours in organic and physical chemistry and perhaps a growing tendency to offer qualitative organic analysis.

Summarizing: It is evident that in the schools of the thirty-four teachers contributing to this questionnaire, the curriculum of the average chemistry major consists of approximately 40 hours of chemistry, 40 hours in the supporting fields of mathematics, physics and biology, and 40 hours in the general curriculum including foreign language.



SCIENCE TRAINING

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289 Illustrations. 355 Pages. \$3.75 (1943)

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FUNDAMENTALS OF SHOPWORK. David J. Swartz, Haaren High School, New York City; Milton J. Gunerman, associate editor of *Home Craftsman* magazine; and Alhponse Lafon, Haaren High School, New York City. Henry Holt and Company, New York, 1943. 467 pp., 318 illus. \$1.60, list.

The book provides the basis for a one semester course in shop work for the eleventh or twelfth year. It carefully follows the outline prepared by the War Department's Pre-Induction Training Section and the U. S. Office of Education. The material is written in a clear and simple manner that should make it easy to follow. It is evident from the presentation that the authors are masters in their special fields. Very good questions and self testing exercises are found at the end of the chapters.

INVESTIGATIONS IN CHEMISTRY. Kenneth E. Conn, Michigan State Normal College, Ypsilanti, Michigan and Herman T. Briscoe, Indiana University, Bloomington, Indiana. Mentzer, Bush and Company, Chicago, 1943. 384 pp., 105 illus.

Investigations in Chemistry is a new work book and laboratory manual that is designed to lead the student in a problem approach to the study of chemical principles. It is designed to promote careful thinking and to a great extent stresses practical applications of the subject.

The book is organized on a unit basis with a preview and orientation material at the beginning and questions for checking up on the learning at the end. The many illustrations make it attractive as well as easier to follow. Provision is also made for individual differences of the pupils.

GENERAL SCIENCE WORKBOOK: Revised. Gilbert H. Trafton, State Teachers College, Mankato, Minn.; Victor C. Smith, Ramsey Junior High School, Minneapolis, Minn.; and W. R. Teeters, Supervisor of Science, St. Louis Public Schools. J. B. Lippincott Company, Chicago, 1943. 310 pp. 205 illus. \$1.00, list.

This workbook in general science provides an easy as well as interesting and effective approach to the study of the usual problems of the general science course. The pupil is led into the study of a unit by simple questions which he can usually answer and by a brief discussion. At the end of the unit is a study test to help check up on the learning outcomes. Writing is limited to a minimum for the pupil. As the answers are recorded in more or less objective form, the book can be graded by the pupils. A separate test booklet is available for the convenience of the teacher.

BASIC RADIO PRINCIPLES. Maurice G. Suffern, Captain Signal Corps, Army of the United States. McGraw-Hill Book Company, New York City, 1943. 256 pp., 269 illus. \$2.25, list.

This book is designed to train radio repairmen and technicians on a vocational-education level, but will also be found useful in any beginners course in radio, or with the radio club, where the students already have the basic concepts of electricity. As it is non-technical and non-mathematical, it will be of special interest to students not well prepared in mathematics and physics. The book provides material for approximately two hundred hours of study.

LOOK AND LEARN. Wilbur L. Beauchamp, Gertrude Cramp-ton, and William S. Gray. Scott, Foresman and Company, 1943. 40 pages of teacher helps and 64 pages of pictures.

Look and Learn is designed for teaching science concepts as well as habits of careful thinking on the first and second grade levels. It should help to develop the ability to observe accurately, to note likenesses and differences, to compare. It should help the child to develop some elementary concepts of real value in the science field. The book is attractive and will demonstrate its worth if placed within the reach of any first grade child.

INSTRUCTIONAL TESTS IN ELECTRICITY, 32 pages; **INSTRUCTIONAL TESTS IN MACHINES,** 36 pages. Benjamin C. Gruenberg and Ellsworth S. Obourn. World Book Company, Yonkers-on-Hudson, New York, 1943. Each 16 cents or \$5.00 for 50, net.

The two test booklets cover the outline set up by the War Department for the Pre-Induction Training Courses in fundamentals of electricity and fundamentals of machines. They consist of 13 and 15 units respectively. The tests are of the multiple choice, modified true-false, and completion questions. All tests are objective and may be quickly scored by means of a strip key that is provided. The tests offer a means for an early diagnosis of deficiencies so that these deficiencies may be corrected.

AEROPLANES AND HOW THEY FLY. Longmans, Green and Co., New York City, 1942. 44 pp. 12x17.5 cm., illus. 40 cents.

This booklet is suited to study on the junior high school and high school level. It is simply written and is intended as a first introduction to the theory of aeronautics. No mathematical formulae are included.

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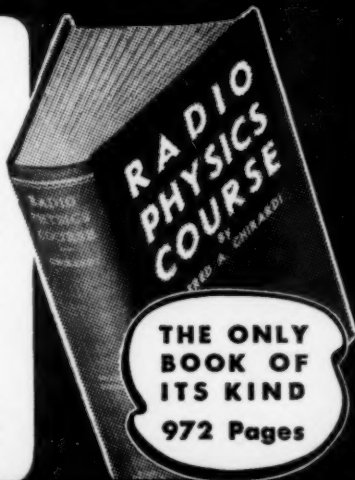
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RADIO & TECHNICAL PUBLISHING CO., 45 Astor Place, New York, N. Y.

SCIENCE. Ira C. Davis, University High School, University of Wisconsin, and Richard W. Sharpe, George Washington High School, New York City. Revised edition. Henry Holt and Company, 1943. 495 pp. 15x23 cm. 403 line drawings, many pictures. Separate teachers manual. \$1.84.

This text covers the field of general science quite thoroughly, including the usual material found in most texts. However the material is chosen to relate to the common activities, interests and experiences of the pupils, so that it is easy to study. The language is simple and the facts are clearly presented. The introductory stories at the beginning of each chapter, showing the progress in the area, increases the interest of the student and help to give a mental set for the material to be studied. The book is quite up to date as to modern applications is concerned. Considerable attention is given to the mechanics of air flow, streamlining and the airplane.

The book is well illustrated, attractive, and should simplify teaching of general science.

BASIC ELECTRICITY. Wilbur L. Beauchamp and John C. Mayfield. Scott, Foresman and Company, Chicago, 1943. 312 pp. 19.5x28 cm. 305 illus. \$1.60, list.

Basic Electricity meets the specifications of the War Department as given in the Pre-Induction Training Course Outline, No. PIT 101, but does it in a very acceptable way. Each unit begins with a set of exploratory questions for orientation and motivation and closes with a check list of questions and problems to test whether the principles have been really learned.

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MODERN SCHOOL GEOMETRY: Revised, with *Aeronautics Supplement*. Clark and Smith. World Book Company, Yonkers-on-Hudson, New York, 1943. 466 pp. illus. \$1.44, list. *Aeronautics Supplement* separate, 10 cents.

An aeronautics supplement has been added to the text and can be had separately, if desired. It comprises the last 16 pages of the text and applies geometry in the flight field. It should prove of interest in preflight work as well as help in the regular geometry course.

THE HUMAN EYE IN ANATOMICAL TRANSPARENCIES. Dr. Peter C. Kronfeld, Illinois and Northwestern Universities, and Dr. Stephen L. Polyak, University of Chicago. Paintings by Gladys McHugh, University of Chicago. Bausch and Lomb Press, Rochester, N. Y., 1943.

This new book on the human eye is notable for a series of 34 remarkable natural color paintings which reproduce in stereographic form the complete serial dissection of the eye and orbit. A new method of graphic reproduction of the paintings, which have the effect of providing the reader with a translucent, three dimensional model of the object which can be cleaved at will along any one of a number of planes.

The drawings are reproduced twice the actual size of an adult eye. In the case of the veins and nerves, which appear respectively in blue and yellow, some realism has been sacrificed to diagrammatic representation in order to distinguish them from arteries. The optic nerve, however, is shown in natural color.

The text has been organized to present not only a systematic account of the anatomy of the eye, but also a topographic treatment as it presents itself in the paintings presented.

AIR NAVIGATION, PART FIVE, RELATIVE MOVEMENT. 108 pages, photo-offset. McGraw-Hill, 1943.

This is the concluding number of McGraw-Hill's series on air navigation.



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Continued from page 31

world better qualified to win each others respect and admiration and friendship than the Russians and the Americans."

I daresay that the extent to which the U.S.S.R. and the U.S.A. will collaborate in the future progress of civilization, not only in economic intercourse, but also in the realm of culture, in the field of pure and applied science and in the philosophy and administration of education, has yet to be revealed to many of us. In the words of Dr. Corliss Lamont, Chairman of the National Council of American-Soviet Friendship, "The American people still have a considerable distance to go in understanding the true nature of Soviet life and civilization, in going behind the headlines about Soviet victories to find out the precise reasons for the magnificent Soviet showing in this war."

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NEW BOOKS

Vitalized Physics. Robert H. Carleton, Summit High School, Summit, N. J.; and Michael N. Idelson, Abraham Lincoln High School, Brooklyn, N. Y. College Entrance Book Company, 1943. 378 pp. illus. In two colors.

Elementary Electricity. Edgar P. Slack, Polytechnic Institute of Brooklyn. McGraw-Hill Book Company, New York City, 1943. Prepared in conformance with official pre-induction training course outline No. PIT 101. 305 pp., 13.5x20.5 cm. illus. \$2.00, list.

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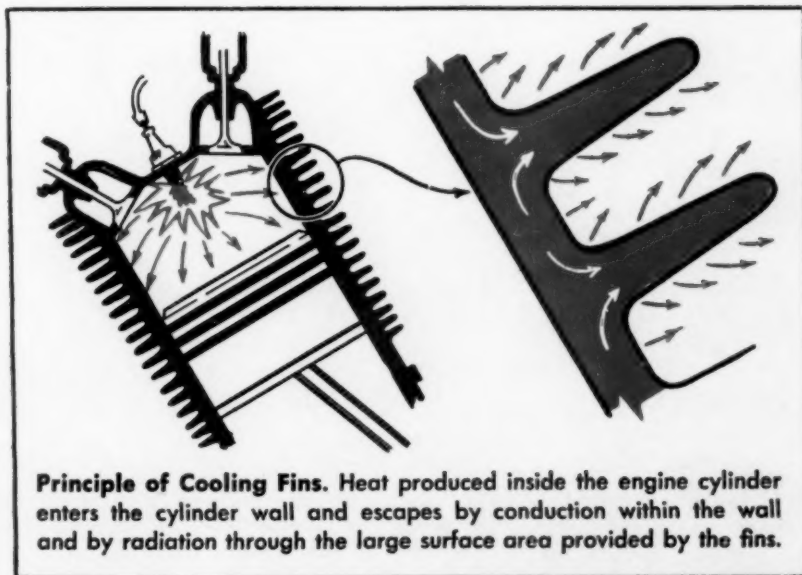
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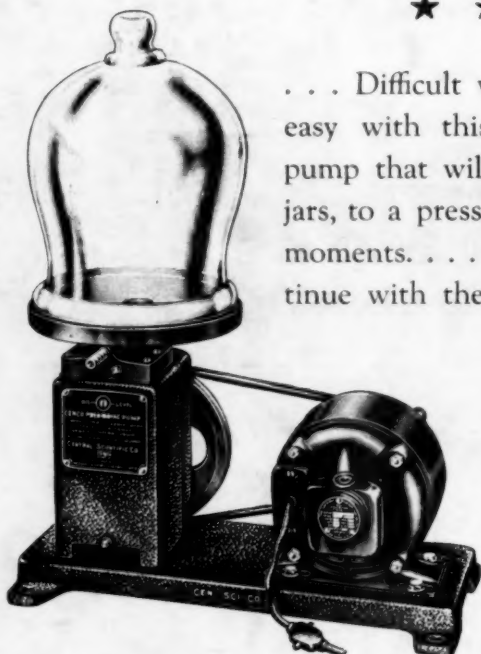


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